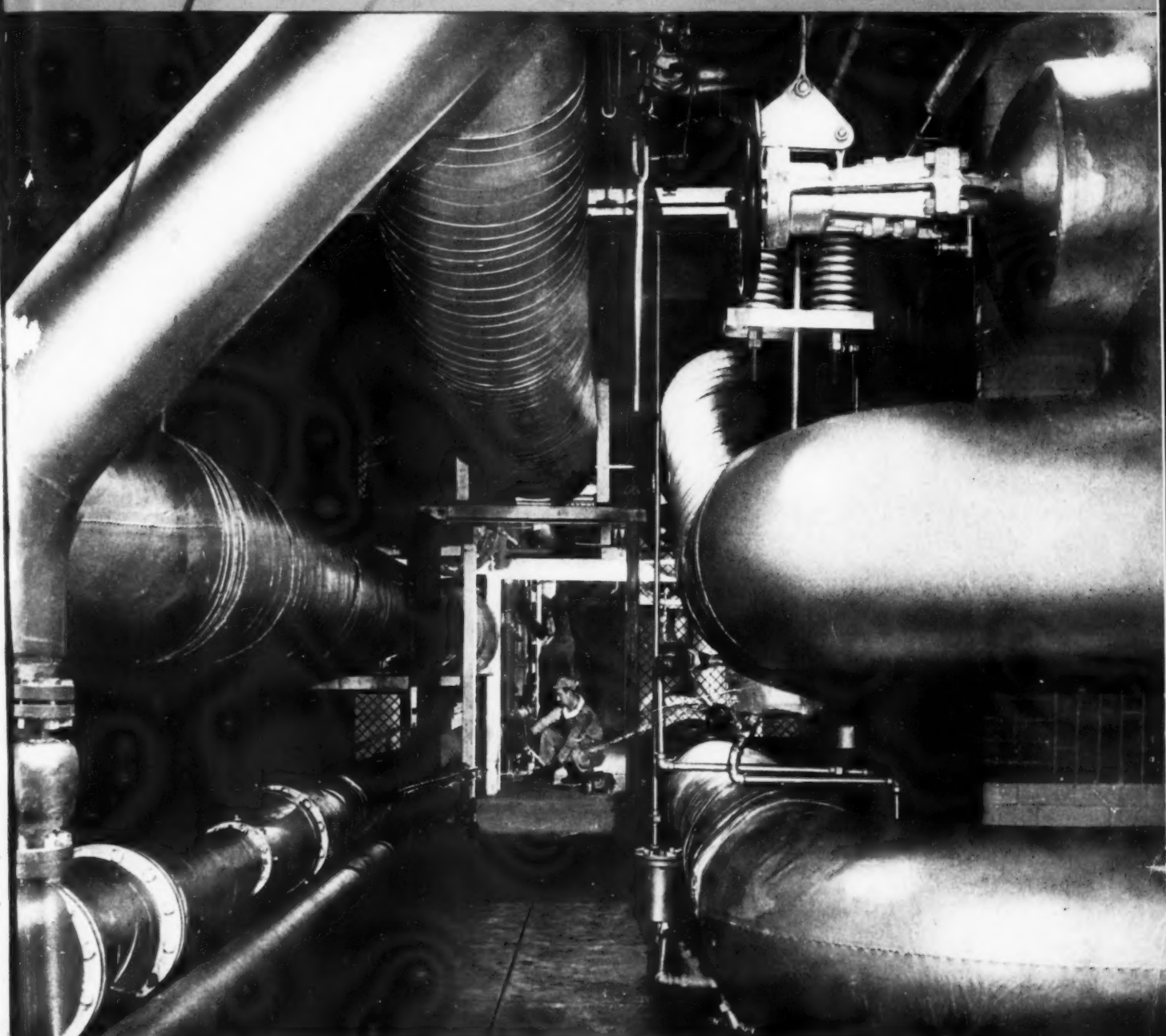
NOVEMBER 1946

POWER

TECHNOLOGY DEPT

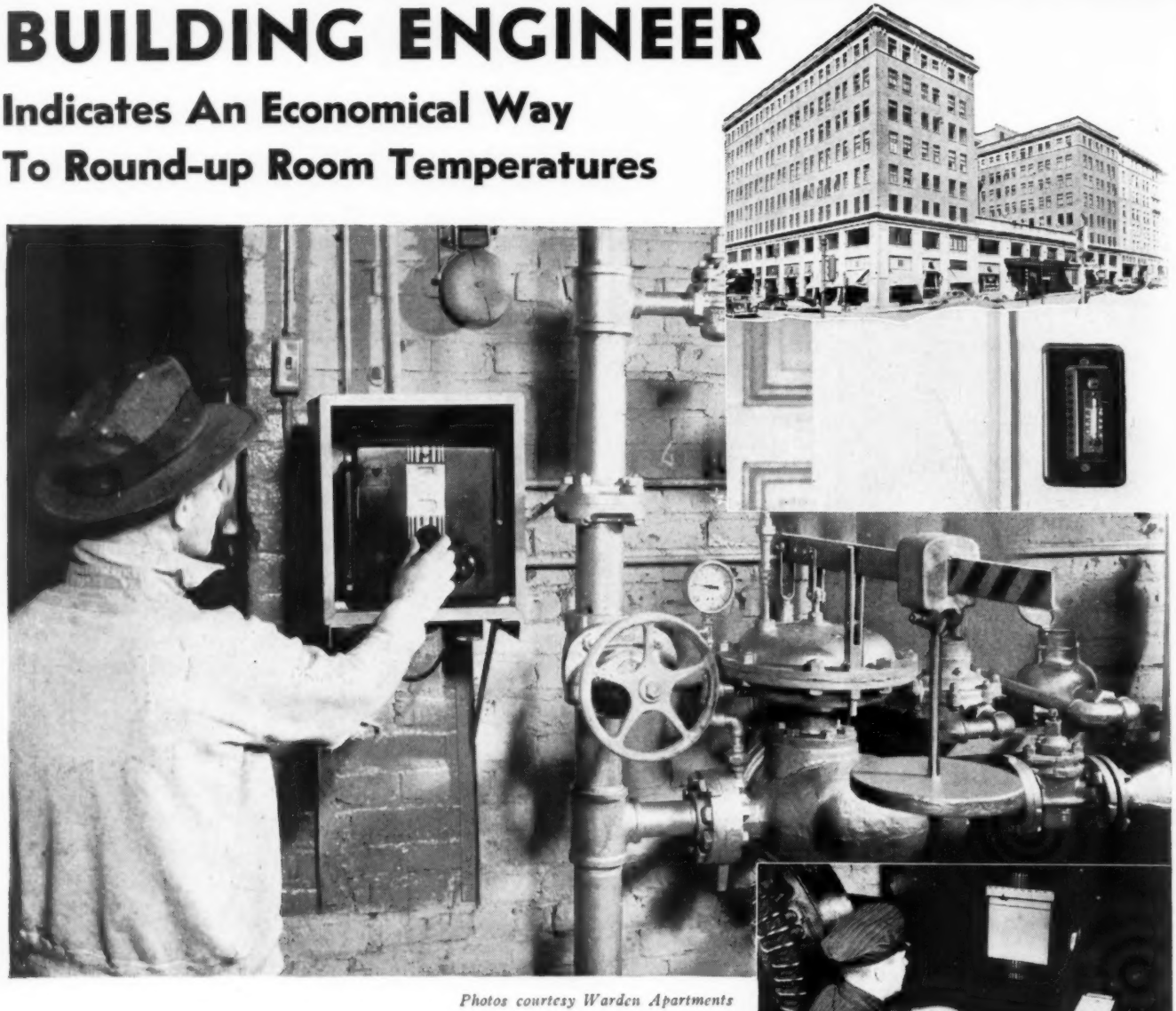
GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES



IN THIS ISSUE: Gas-turbine application data, p 64; Design of high-temperature piping, p 68; Atomic-power cost estimates, p 78. **TABLE OF CONTENTS, p 59**

BUILDING ENGINEER

Indicates An Economical Way To Round-up Room Temperatures



Photos courtesy Warden Apartments

Recorder photo courtesy H. P. Hood & Sons, Boston

The man in the boiler room of the Warden Apartments, Fort Dodge, Iowa, reads temperatures throughout the building from an L&N Temperature Indicator . . . in turn served by sensitive Thermohms at the various locations.

His quickly-taken readings tell him exactly where more heat is needed, where less heat will do. He can do an efficient job of keeping the apartments at a consistently comfortable temperature, while using fuel wisely.

There are many applications for this step-saving, complaint-preventing instrument. Where more than an Indicator is needed, Micromax Recorders and Controllers can be supplied to show as many as 16 temperature points. If you'll describe your problem, an L&N engineer will gladly give his specific recommendation. Or we'll send Catalog N-33C, as you prefer.

Why This Is a PRACTICAL Help Toward Better Building Temperatures!

1 Indicator and Thermohms (detecting bulbs) are easy to install. No tubing required—just copper wire for 1½ volts.

2 Thermohms can be moved, repaired or replaced without affecting the instrument's calibration.

3 Indicator retains its accuracy. No calibrated springs or jeweled bearings—cleaning is the only attention needed.

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-33C-225(2)

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50 miles of PECK CARRIER hold handling costs down

Inset shows action of automatic dumper; discharge is positive and complete.

● In its field, the Peck overlapping, pivoted-bucket carrier offers the lowest cost and most dependable type of conveying . . . proved by more than fifty miles of installations handling coal, ashes and other materials. Many Peck carrier units have been in continuous use twenty years and longer, attesting to the dependability, long life and economy of this equipment.

Since the buckets at all times maintain their carrying position by gravity, a single carrier can transport coal or ashes horizontally, vertically and again horizontally, or on any desired path. The material is *carried* in buckets, supported by rollers of large diameter in connection with two strands of specially constructed rolling chain; therefore friction and power requirements are reduced to a minimum. The material can be discharged at a number of points, merely by pre-setting the dumper which is used for engaging the cams on both sides of buckets. Each bucket rights itself to normal carrying position, and the dumping will continue automatically until moved to a new location. Can be used in cramped space. Standardization of individual units and assemblies assures interchangeability and makes possible combinations practically limitless. For details write for Book No. 1720.

LINK-BELT COMPANY

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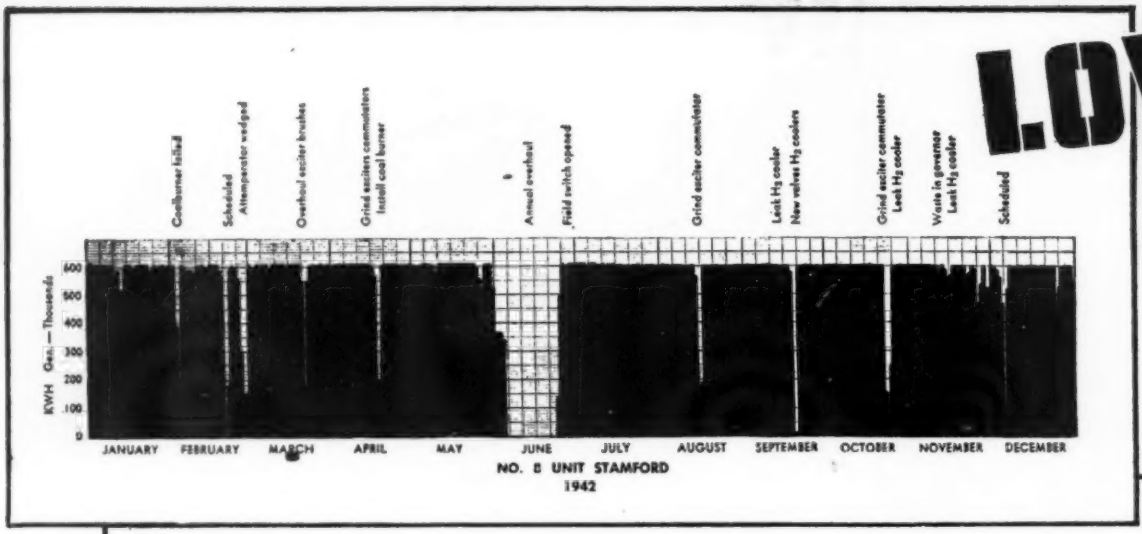
10,282

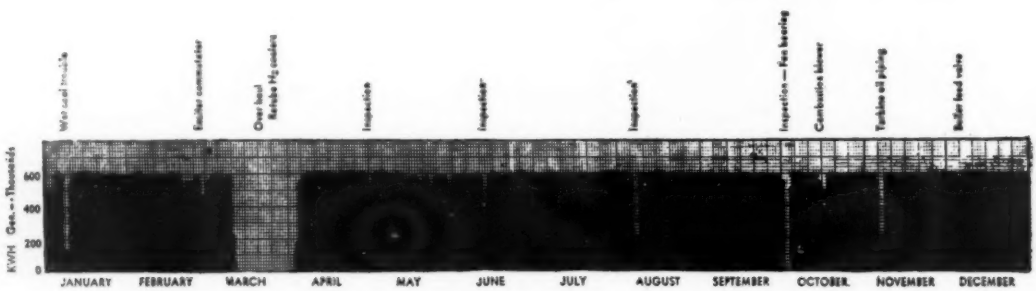
LINK BELT

COAL AND ASHES HANDLING EQUIPMENT

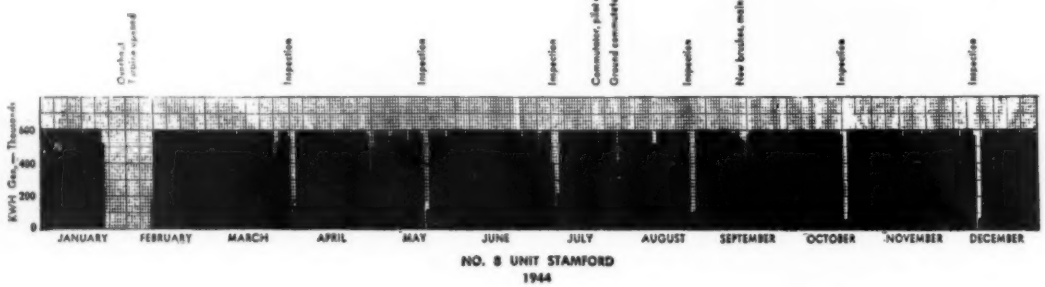
LOW-



NO. 8 UNIT STAMFORD
1942



NO. 8 UNIT STAMFORD
1943



NO. 8 UNIT STAMFORD
1944

NO. 8 UNIT STAMFORD
1945

COST POWER

B & W PERFORMANCE FILE #17

CONNECTICUT POWER CO.
STAMFORD, CONN.

OBJECTIVE: To balance installation costs, maintenance expense, and thermal efficiency to give the lowest over-all cost of electrical energy. . . .
—from statement of engineers BEFORE installation.

APPROACH: Addition of a new base-load unit consisting of a 25,000-kw. turbine and a 250,000 lb. per hour B&W Radiant Boiler.

% OF TIME ON LINE: Here is the "on-the-line" record of this unit for complete years since its installation:

1942	90.9		
1943	89.9	1944	92.0
		1945	93.3
Four-year average	91.5		

CAPACITY FACTOR:

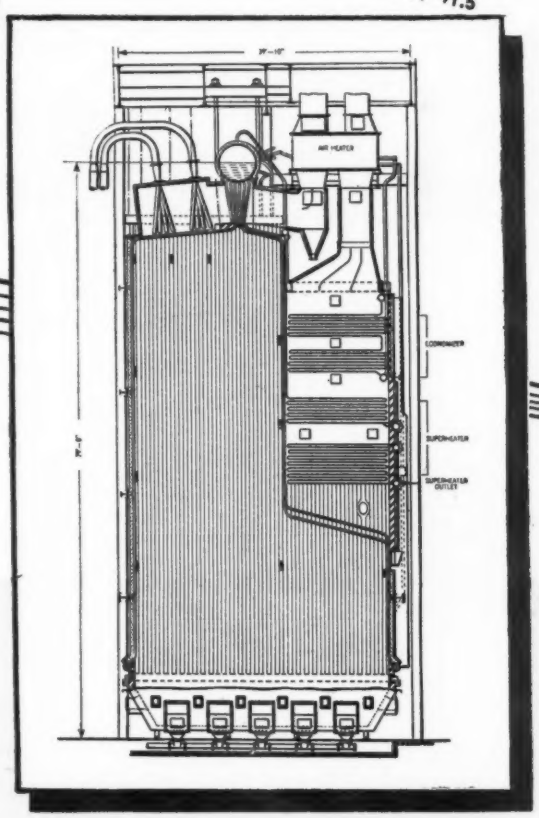
1942	89.2	1944	90.4
1943	87.9	1945	90.0
Four-year average	89.4		

OUTAGE TIME CHARGEABLE TO BOILERS: One-tenth of one per cent since put into operation in October 1941.

CONDITION: No slag around burners, on side or rear walls in burner area, or in superheater. Slag formations elsewhere negligible or easily removed without shutdown. Original superheater tubes still in service. Turbines have never required cleaning and have shown no deposits at normal inspection periods.

SATISFACTION: The performance record of B&W boilers at Stamford is further evidence of the dependability, continuity of operation and low ultimate cost that is built into all B&W units, and in the words of engineers of the Connecticut Power Co. after four years' operating experience with this unit: "A conservatively designed unit conservatively run pays dividends."

Also at Stamford are four 600 hp. B&W Boilers and two 180,000 lb. per hr. B&W Boilers.



B&W Radiant Boiler installed in Stamford Station of Connecticut Power Company in 1941. Maximum continuous steam capacity—250,000 lb. per hr. at 975 psi and 915F. Designed for vertical firing with either pulverized coal or oil.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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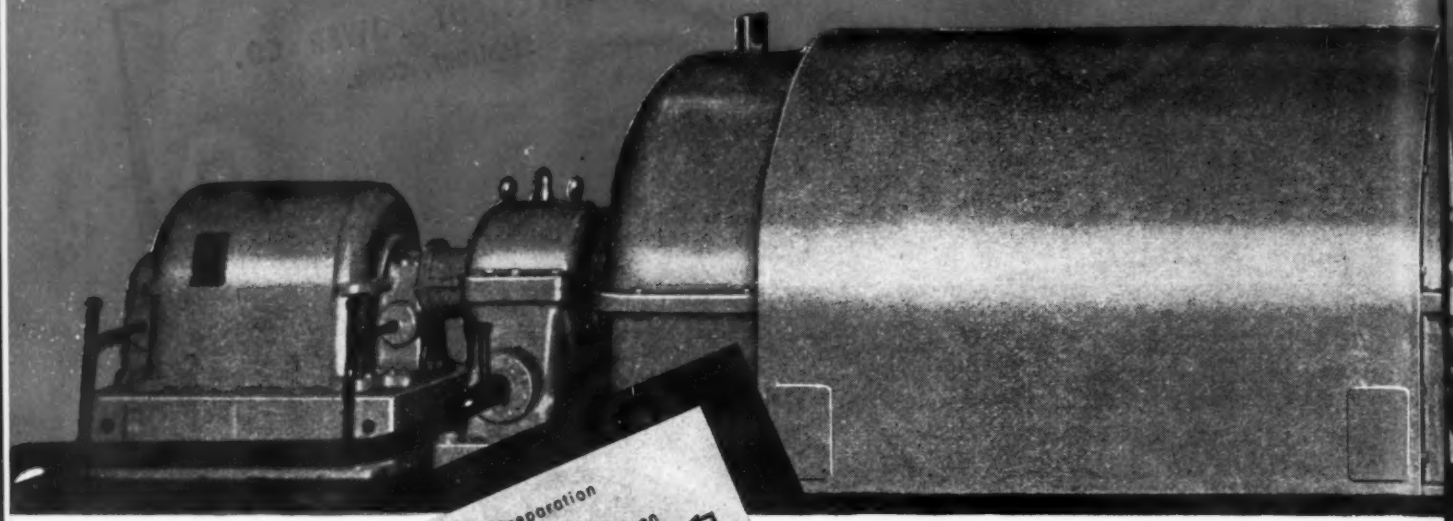
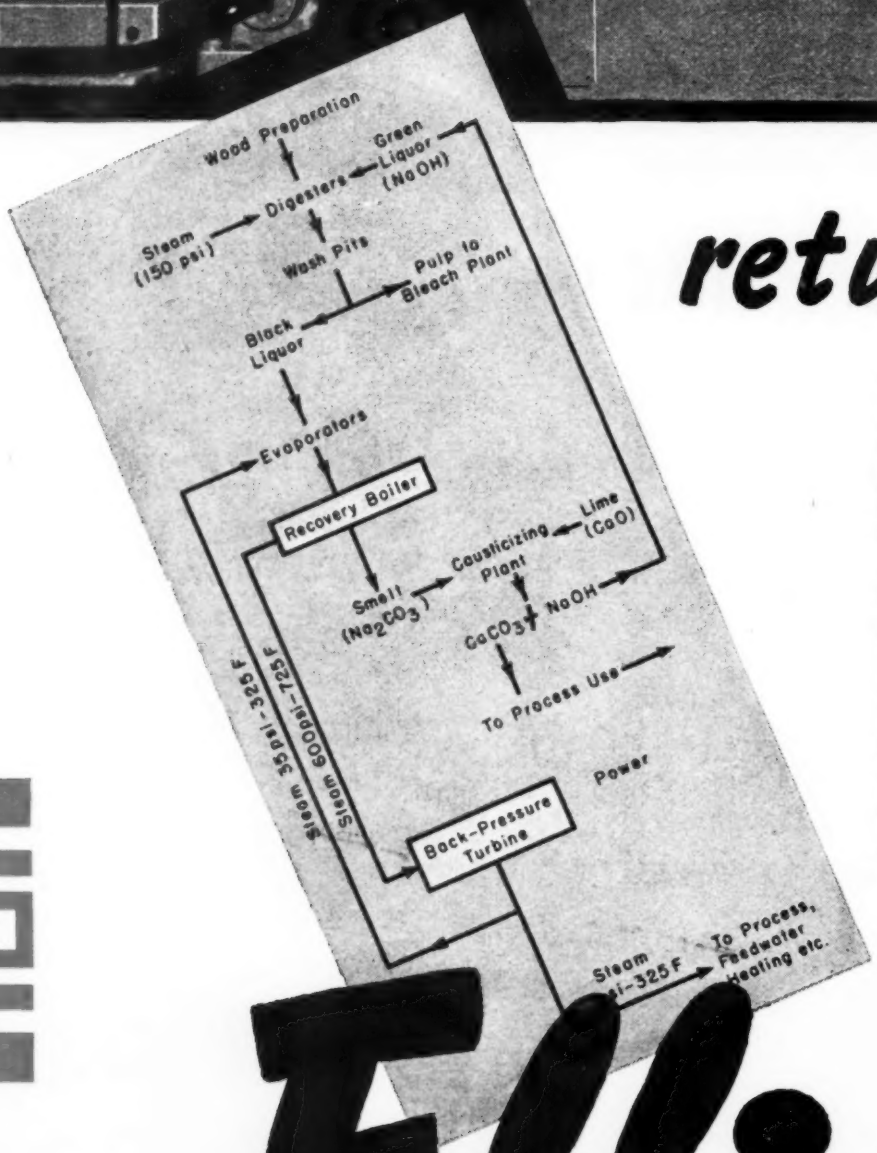
G-325

Adventure in economy.





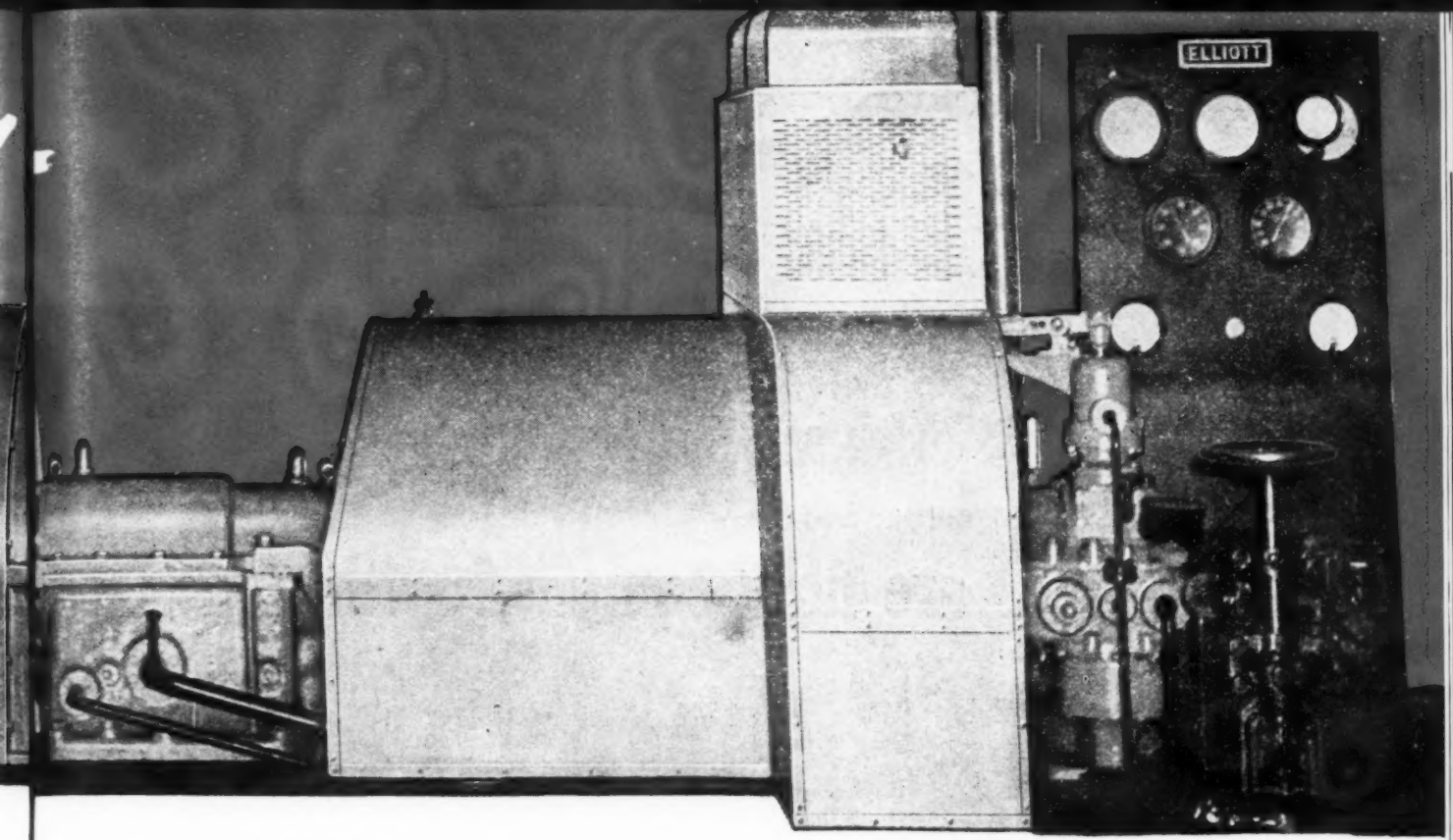
returning

This schematic diagram shows how the boiler and turbine fit into the pulp making process. The Elliott turbine-generator is a 3000-kw unit, operating on 600-psi steam, and exhausting at 35 psi to process, feedwater heating, etc.

Another Elliott 4000-kw turbine-generator unit is now being installed in this plant.

There are also a number of Elliott mechanical drive turbines on various pumps, and Elliott synchronous motors driving forced- and induced-draft fans, wood chippers, jordans, and pumps. An Elliott two-stage steam jet ejector is used in process, and Elliott strainers for clearing water. Elliott tube cleaners are also used to maintain boiler efficiency.

Elliott



ghe full investment in three to five years

The S. D. Warren Company, large paper manufacturers, has long shown a strong pioneering spirit not only in the development of new and better paper products, but also in improved operating methods. At their Cumberland Mills, Maine, they have completed a new by-product power and steam plant using as fuel the "black liquor" resultant from the wood pulp process. This black liquor has a fuel value of approximately 6000 Btu per lb of dry solid matter. Its burning permits the recovery of sodium carbonate, the recovery of heat and generation of steam at high pressure, and the generation of by-product power by means of a back-pressure turbine exhausting into the mill for process use. The combined savings in steam, power and chemicals promise to write off the capital investment in 3 to 5 years.

Considering the high degree of engineering skill shown in this plant development, the selection of an Elliott turbine-generator is particularly significant.

ELLIOTT COMPANY
Steam Turbine Dept., JEANNETTE, PA.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

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STEAM TURBINES • GAS TURBINES • GENERATORS • MOTORS • CONDENSERS
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TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

1765 Boilers
are now equipped with
DIAMOND
"AIR PUFF"
Soot Blowers

In the 15 years since Diamond Automatic Sequential "Air Puff" Soot Blowers were first installed, 1765 boilers have been equipped with them. Year after year the successful operation of the rapidly increasing number of these blowers is convincing testimony to the soundness of the Diamond "Air Puff" blowing principle.

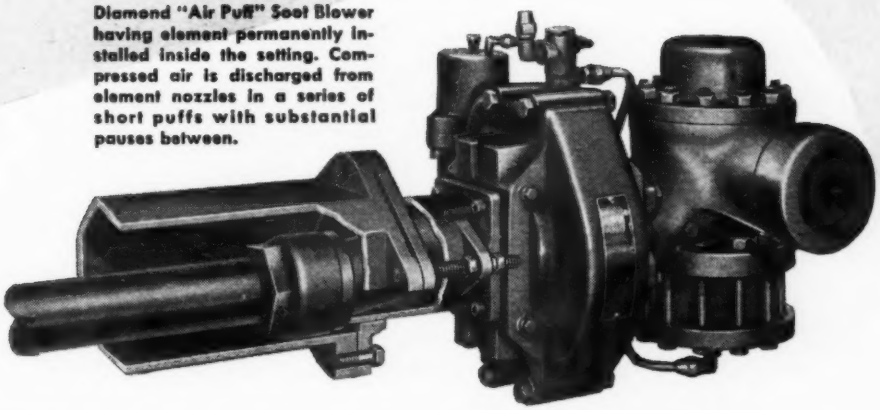
Practically every type, size and pressure are included in the 1765 boilers—heating—marine—power—up to public utility giants of 900,000 pounds per hour capacity. "Air Puff" Soot Blowers are used alone and in combination with the other types of Diamond Soot Blowers.

Compressed air has a greater density than steam and therefore provides better cleaning. The air is discharged in a series of short puffs with substantial pauses between. Spreading the cleaning cycle over a longer period of time permits use of a much smaller compressor and receiver. The many other advantages of Diamond "Air Puff" Soot Blowers are briefly mentioned on the right-hand page. Write for further information.

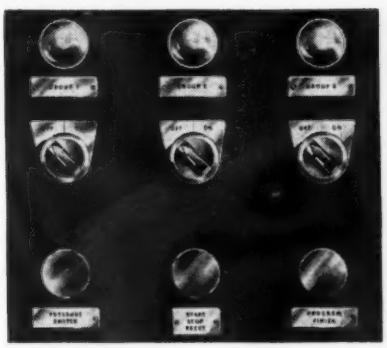
DIAMOND POWER SPECIALTY

DIAMOND SPECIALTY LIMITED,

Diamond "Air Puff" Soot Blower having element permanently installed inside the setting. Compressed air is discharged from element nozzles in a series of short puffs with substantial pauses between.



Master Controller which automatically controls the sequence and blowing time of Diamond "Air Puff" Soot Blowers only. Just a twist of the wrist to open a valve . . . the controller does the rest.



Program panel for controlling Diamond "Air Puff" Soot Blowers in combination with other blowers. All are operated in correct sequence and at right blowing speed by simply pushing one "start" button.

AUTOMATIC SEQUENTIAL OPERATION

ASSURES CORRECT CLEANING	"Human element" is entirely eliminated and each blower unit must operate in correct sequence and at right speed every time. No unit can be overlooked by careless operator.
SAVES LABOR	No attendant needed to drain piping, warm it up, and then operate each individual blower unit.
SAVES FUEL	Uses only ⅓ to ⅔ of energy from coal pile needed for steam blowing.

OTHER "AIR PUFF" ADVANTAGES

NO FEED WATER MAKEUP	Using compressed air instead of steam as cleaning medium, there is no condensate loss due to soot blowing.
STACK DISCHARGE NUISANCE MINIMIZED	Intermittent operation expels soot from boiler in small quantities.
REDUCED MAINTENANCE	Many years' experience proves maintenance costs are unusually low.
PIPING INSULATION ELIMINATED	When air is used for cleaning, soot blower piping is not insulated.

CORPORATION DETROIT 31, MICHIGAN

WINDSOR, ONTARIO

How BAILEY CONTROLS Save Money

Fuel

1. Average saving as reported by users is 5%.
2. Waste fuel automatically used, when available, by Multi-Fuel firing.
3. Flexibility of control simplifies switching to most economical fuel.

Maintenance

1. Furnace wall repairs reduced by limiting maximum furnace temperature through close control of excess air.
2. Slagging of heating surfaces reduced to a minimum by accurate control of excess air.
3. Feed water pumps protected at low ratings by automatic by-pass control.
4. Possible damage to turbine from water carry-over avoided by feed water control.
5. Damage from excessive steam temperature avoided by proper control of excess air and superheat.
6. Burning of tubes insured against by proper control of feed water and excess air.

Auxiliaries

1. Power required by fans is less since control continuously operates on minimum allowable excess air.
2. Power for feed pumps may be reduced through control of excess pressure by pump speed.

Steam Use

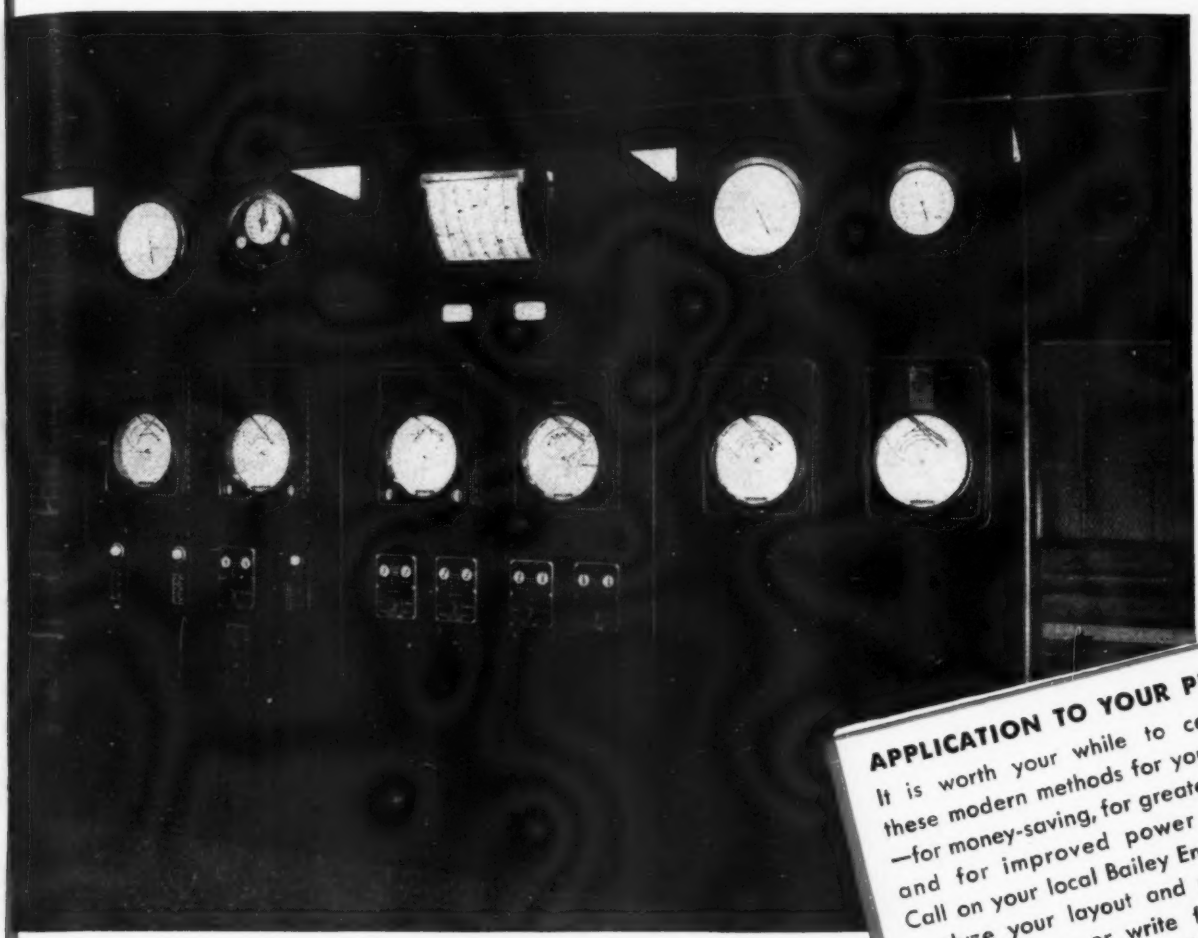
1. Maintains Prime Mover efficiency by supplying steam at design pressure and temperature.
2. Improves process operation by controlling flow, pressure and temperature.

BAILEY METER COMPANY

1036 IVANHOE ROAD • • • CLEVELAND 10, OHIO

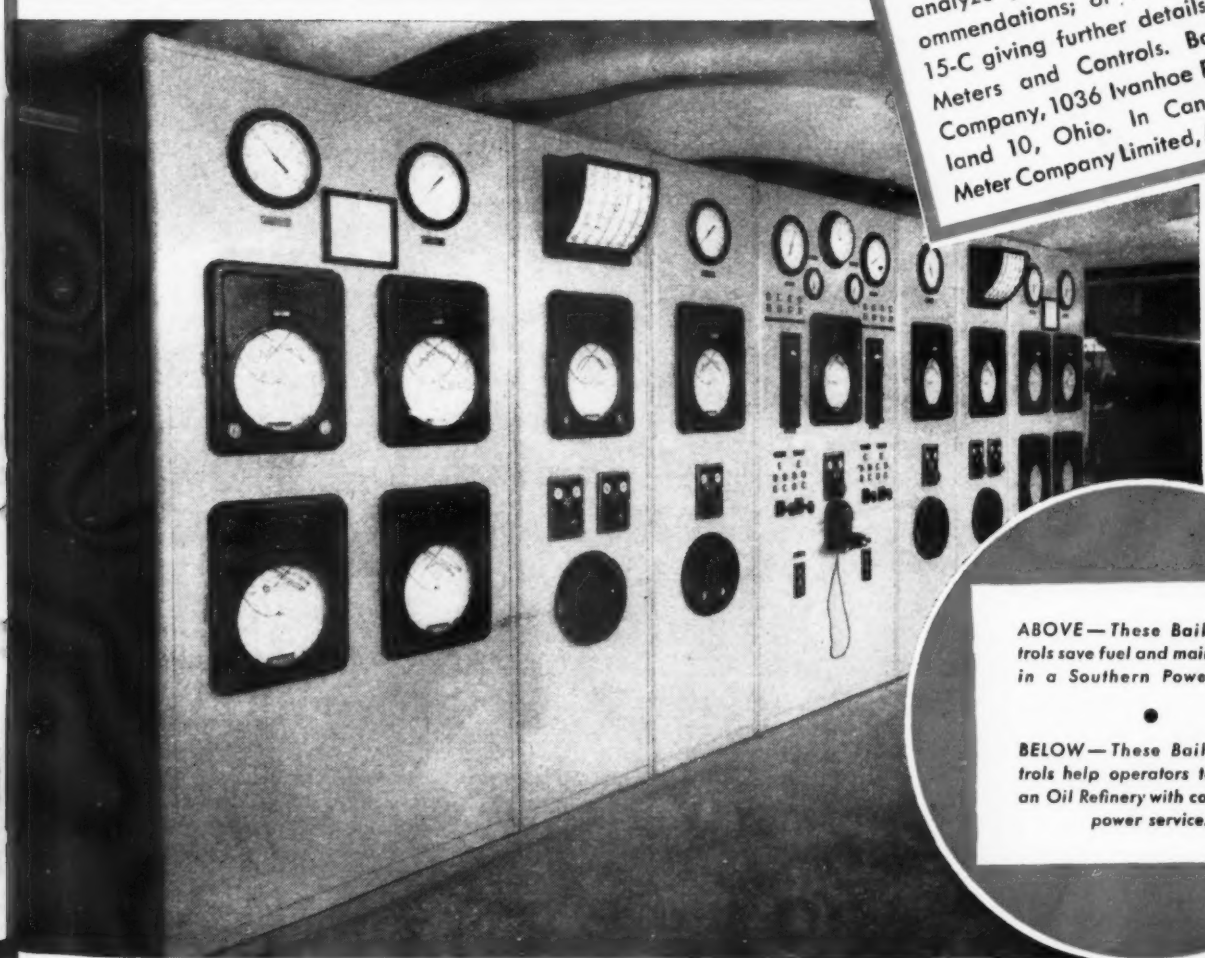
Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS



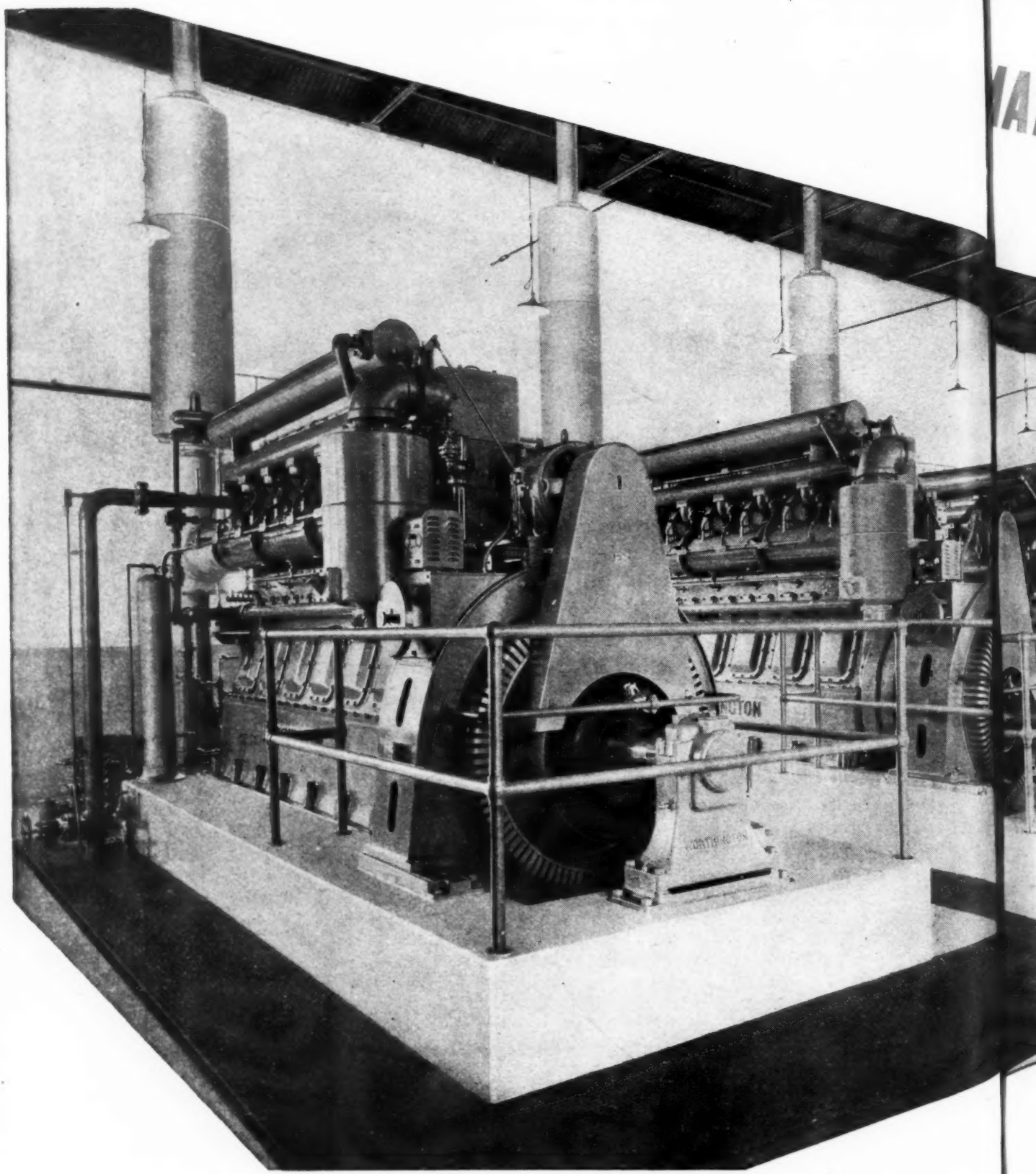
APPLICATION TO YOUR PLANT

It is worth your while to consider these modern methods for your plant —for money-saving, for greater safety and for improved power service. Call on your local Bailey Engineer to analyze your layout and make recommendations; or write for Bulletin 15-C giving further details on Bailey Meters and Controls. Bailey Meter Company, 1036 Ivanhoe Road, Cleveland 10, Ohio. In Canada — Bailey Meter Company Limited, Montreal. A-92



ABOVE — These Bailey Controls save fuel and maintenance in a Southern Power Plant.

BELOW — These Bailey Controls help operators to supply an Oil Refinery with continuous power service.



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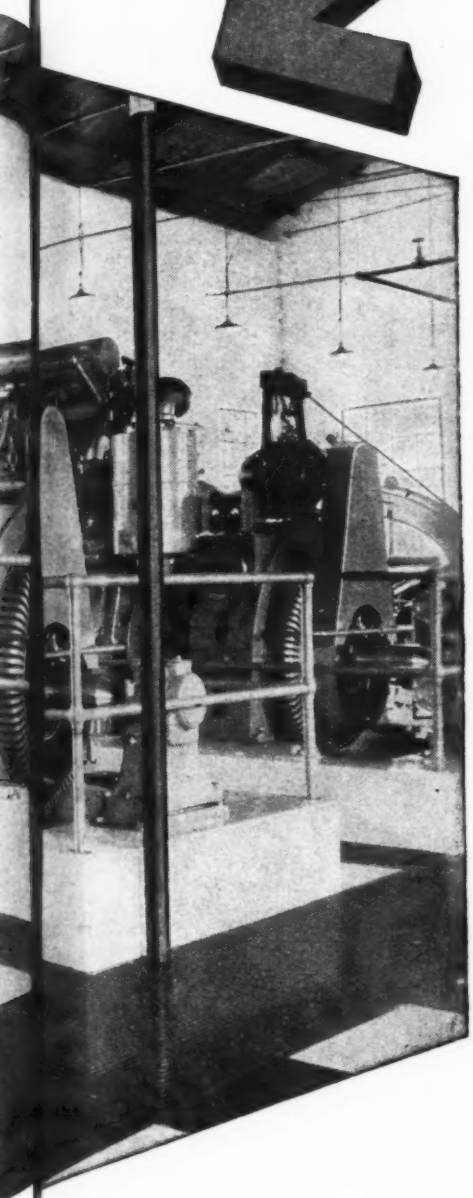
every Sunday night.
See newspapers for
time and station.

TEXACO

MAKE 2 IMPORTANT SAVINGS IN DIESEL OPERATION



FOR low operating cost, lubricate your Diesels with *Texaco Ursa Oils.* You'll *save on fuel, save on maintenance.*

Texaco Ursa Oils stand up in the severest service . . . keep engines clean . . . assure longer life for bearings, liners, rings and pistons. *Ursa Oils* promote maximum engine efficiency . . . dependable, full-power output . . . minimum expense for fuel and maintenance.

There are *Ursa Oils* to assure these advantages and savings in Diesels of every type and size. They are approved by all leading Diesel manufacturers and used by operators the world over. In fact, because of their effectiveness—

More stationary Diesel hp. in the U.S. is lubricated with Texaco than with any other brand.

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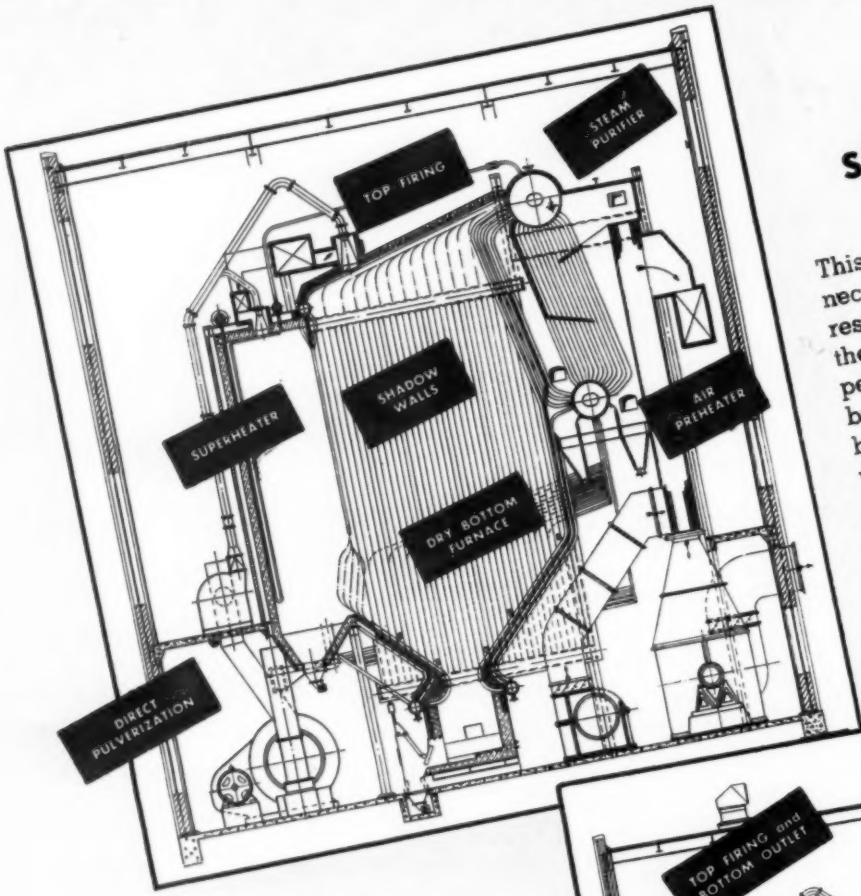
URSA OILS

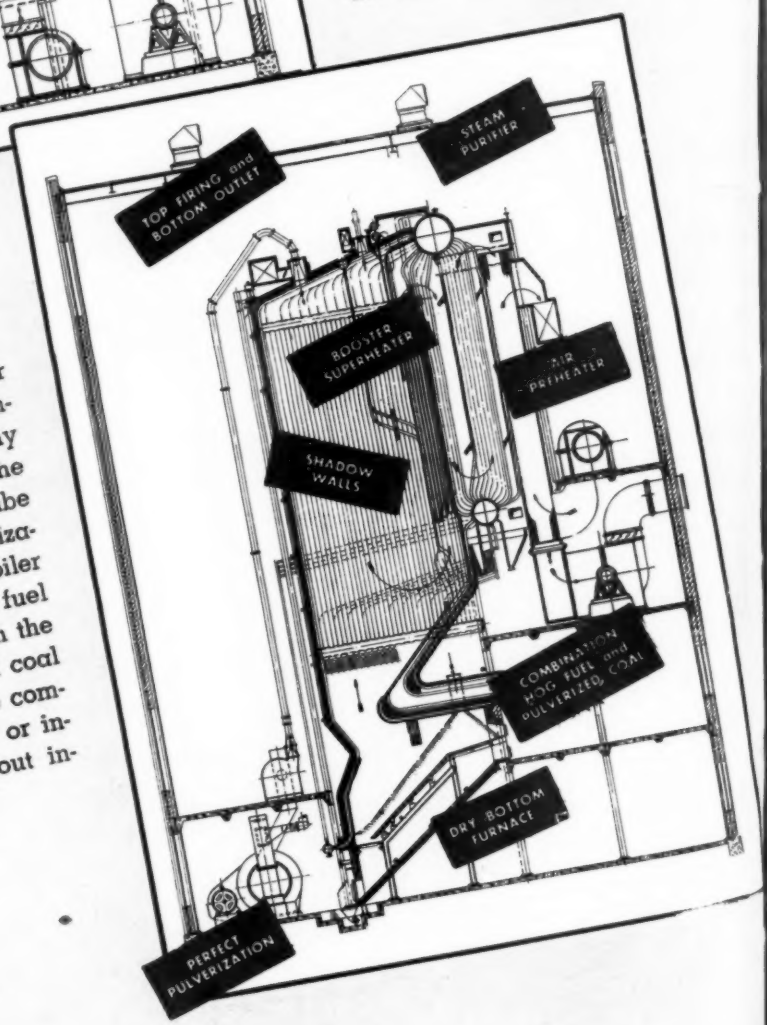
FOR ALL DIESEL ENGINES

KVS STEAM GENERATOR



BOILER WITH SEPARATELY FIRED SUPERHEATER

This two-drum boiler is direct-connected to superheater at top, thereby restricting exhausted hot gases at the bottom. Accurate control of superheat at any steam flow is effected by varying the heat output of the burner which fires into furnace in which the superheater is located. Automatic regulation of fuel and air to burner makes possible the maintenance of uniform steam temperature over any load range or load fluctuation. Close control of the entire unit is maintained at all times.



BOILER FOR TWO KINDS OF FUEL

This two-drum boiler, with superheater and preheater, can be fired with anthracite or bituminous coal and any type coal used when ground in the KVS Integral Drive Air Swept Tube Mill, because of the perfect pulverization assured. A feature of this boiler is that it is designed to burn hog fuel . . . chips bark, waste, etc. . . . on the lower grates. Both the pulverized coal firing and the hog fuel firing are combined to operate either together or independently, as required, without interference one with the other.

DESIGN *takes into account availability of fuels TOMORROW as well as those obtainable TODAY*

Fuel selection and fuel economics are given full consideration by KVS engineers in the design of every steam generator. Flexibility in the choice of fuels is provided for by liberal proportioning of such important components as furnaces, water walls and pulverizers. By so doing, adequate and long range protection is assured against plant outages or uneconomical operation due to possible future shortages of suitable fuel. Insofar as coal is concerned, KVS steam generators are designed for the economical combustion of the full range . . . from anthracite to low fusion bituminous.

In addition to making proper provision in design for wide coal selection, KVS offers a system of coal pulverization which assures superfine pulverized coal *regardless of the quality of coal available.* This system, applicable through the KVS Integral Drive Air Swept Tube Mill to pulverized fuel firing, has a proved record for low power and maintenance costs.

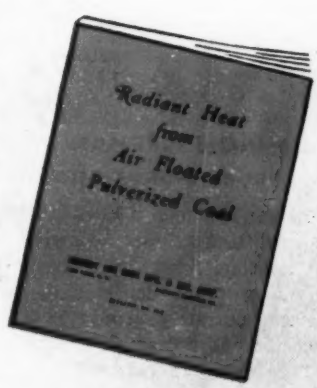
•

KVS Engineering Service

KVS offers a complete service in the design, building and erecting of steam generating plants, ready for owner operation, under one responsibility. Consult KVS Engineers on your requirements.

SEND FOR BULLETIN NO. 44B

This 97-page Bulletin is a fully illustrated engineering handbook on modern steam generation practice. Kindly make your request on your company letterhead.



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Kennedy-Van Saun

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It's time to MODERNIZE

No old stoker can match the efficiency and dependability of the modern Iron

OBSOLETE STOKERS HAVE THESE EARMARKS

HIGH FUEL COSTS

Many old stokers are trying to carry increased loads by using premium coals. Others lack the precision control of fuel and air for most efficient combustion. Coke in ash is a visible evidence of fuel waste, of which many out-moded stokers are guilty. Iron Fireman engineers will analyze your fuel costs without charge.

WASTED BOILER ROOM LABOR

Many old stokers waste man hours because they have high hoppers that are hard to fill. In some cases hoppers and mechanism overhang fire doors, making fire cleaning difficult. Also mechanism that is hard to reach or located in areas of intense heat add to labor costs. Iron Fireman Coal-Flow models feed from main bunker, have no boiler front obstructions, no inaccessible machinery.

EXCESSIVE STACK LOSSES

Although smoke is one evidence of stack loss, some of the most serious wastes occur in smokeless stacks. Out-moded stokers cannot control the combustion processes with sufficient precision to prevent high stack losses. Iron Fireman tests will reveal how much you are paying for such losses.

HIGH FURNACE AND STOKER MAINTENANCE

Watch your repair bills—they may be a warning. An undependable stoker, quite beyond its maintenance cost, may cause losses that amount almost to havoc when stoker breakdown or burned out furnace lining forces a plant shut-down. It is *never* profitable to let a stoker die of old age.

LOW BOILER OUTPUT

Most old stokers are unable to produce the steam output of which the boiler itself is capable. There may be several contributing causes besides the inadequacy of the stoker, such as poor draft conditions, improper installation, etc. Iron Fireman has successfully replaced hundreds of stokers where greater boiler capacity was required.

TIME LAG IN LOAD PICK-UP

Stokers that are not readily responsive to load demands are not only a drag on the whole plant—they are fuel wasters. Iron Fireman stokers, in both the underfeed and pneumatic spreader types, preheat the coal and add both fuel and air without disrupting the fuel bed, and are therefore highly sensitive to load changes.

WITH all fuels rising in cost, Iron Fireman stokers enjoy an outstanding advantage in their ability to burn a wide range of coals, permitting the efficient use of whatever type is most economically supplied by the local market.

Iron Fireman's efficient conveying system not only saves boiler room labor, but often saves large investments in coal handling equipment. Its adaptability to existing boiler room layouts avoids costly alterations.

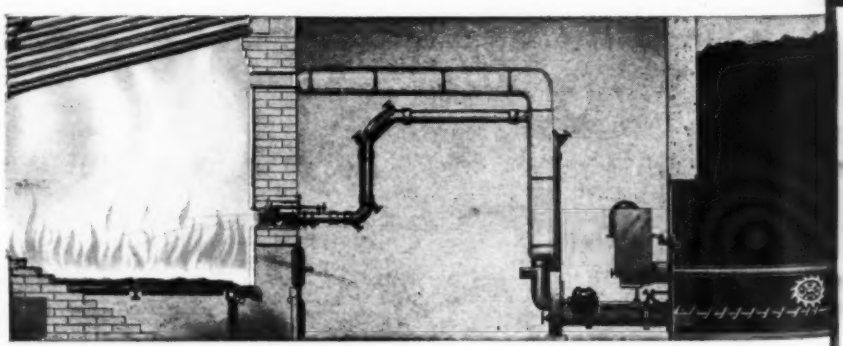
Iron Fireman's instant responsiveness to load variations, and its automatic, continuous control of the fuel-air ratio make the modern Iron Fireman a great fuel saver.

Iron Fireman's exceptional dependability, (which is another word for low maintenance cost) is due to sturdy construction, easy accessibility, and separation of all mechanical parts from destructive furnace heat.

Iron Fireman's nation-wide organization assures an engineered installation, carefully planned in each individual case to get maximum efficiency from your boiler. A routine result of an Iron Fireman installation is increased boiler capacity.

How the IRON FIREMAN Pneumatic Spreader stoker operates

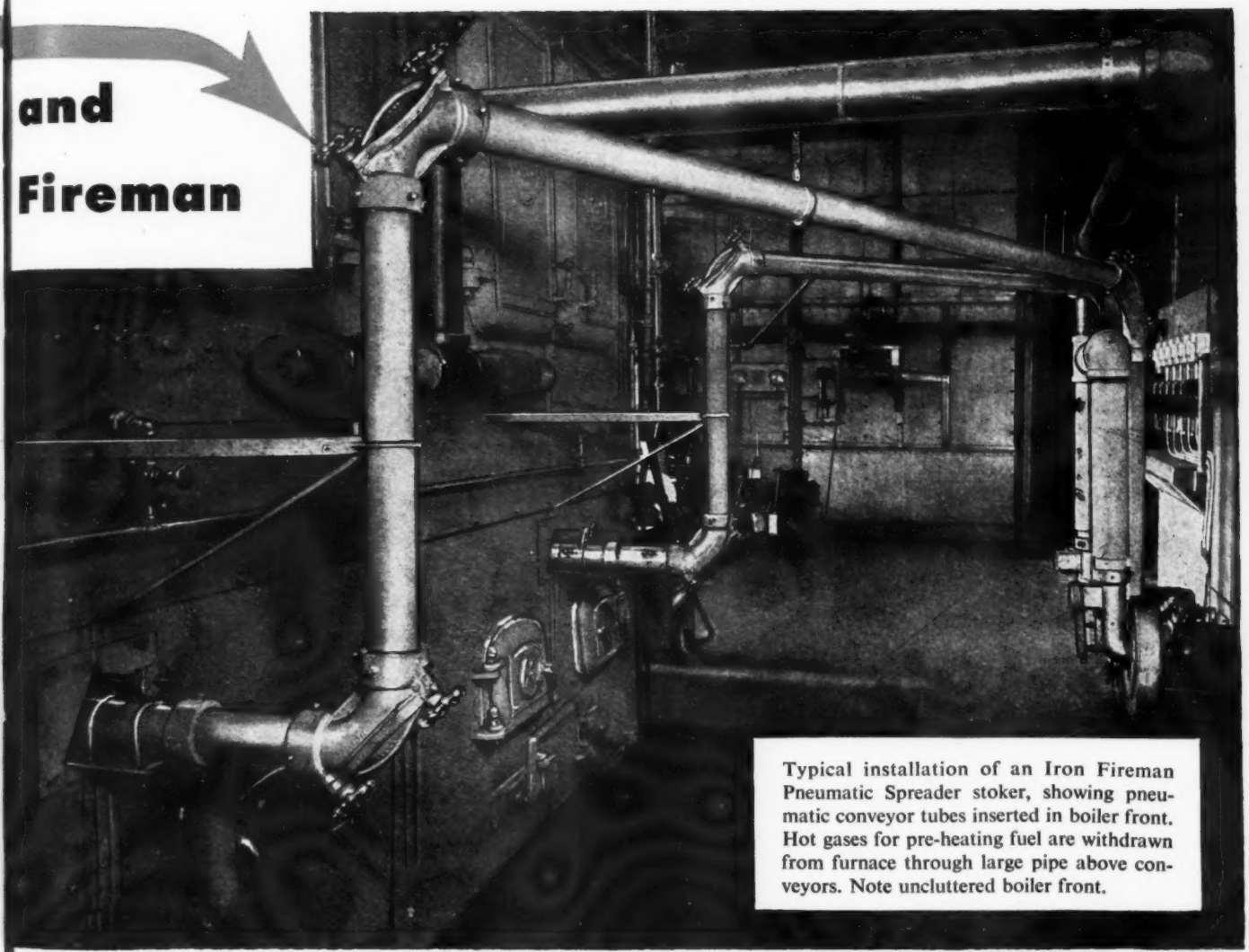
The Iron Fireman Pneumatic Spreader Stoker meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by pneumatic conveyor and delivered to furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which to not preheat fuel.



Heavy Duty Automatic Coal Stokers for Power, Processing and Heating

with an IRON FIREMAN stoker

y and
n Fireman



Typical installation of an Iron Fireman Pneumatic Spreader stoker, showing pneumatic conveyor tubes inserted in boiler front. Hot gases for pre-heating fuel are withdrawn from furnace through large pipe above conveyors. Note uncluttered boiler front.

Do you KNOW what your steam costs are?

Here's how to find out . . . The first step toward reducing steam costs is to know exactly what your costs are now. Iron Fireman engineers are fully equipped to make a factual study of your boiler room operations. They can measure your stack losses, determine the efficiency of your boilers, make a scientific appraisal of stoker and furnace, and tell you how much of the fuel you buy is wasted and how much you are able to apply as usable heat. Their study will also show what an engineered Iron Fireman installation will accomplish in your present boiler.

This service is performed without expense or obligation on your part. Iron Fireman's engineering, sales and service organization covers the continent. Write for engineering survey or for literature to Iron Fireman Mfg. Co., 3048 W. 106th St., Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada. Stokers for every size and type of firing job.

IRON FIREMAN

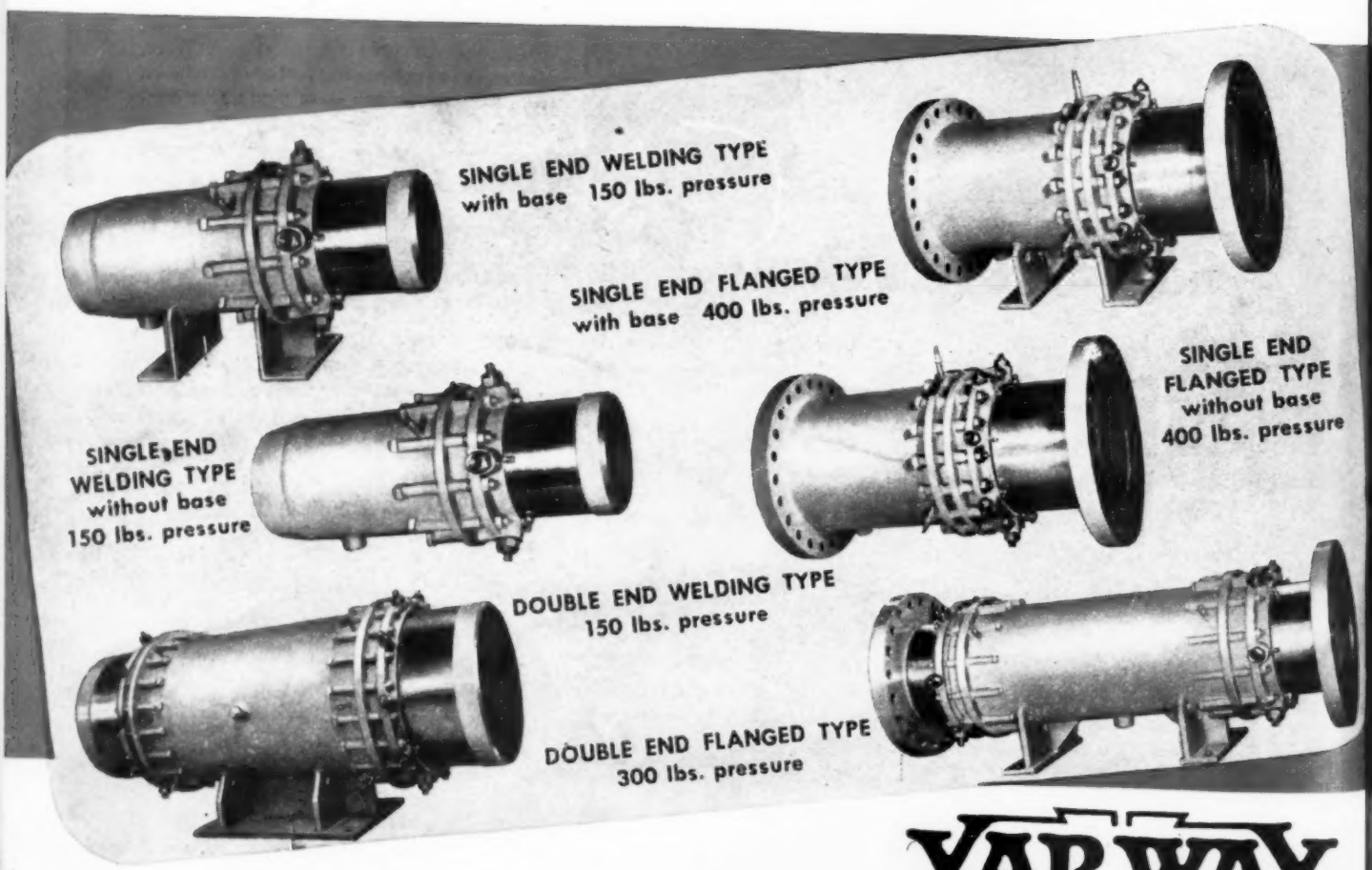
THE IRON FIREMAN

Stop ...shutdown losses and production delays

Look...at the record low maintenance costs

Listen ...to what users say about...

"GUN-PAKT"



YARWAY

JOINTS

YARWAY "GUN-PAKT" EXPANSION JOINTS

Yarway "Gun-Pakt" Expansion Joints are more than an improved expansion joint . . . they are a revolutionary idea that has won the enthusiastic approval of steamplant engineers from coast to coast.

These are the expansion joints that can be serviced *under full steam* pressure. Insert a packing plug, twist a wrench, and the job is done. It's as simple as that! Special Alemite fittings provide for proper lubrication. "Gun-Pakt" means the end of costly shutdown losses and production delays.

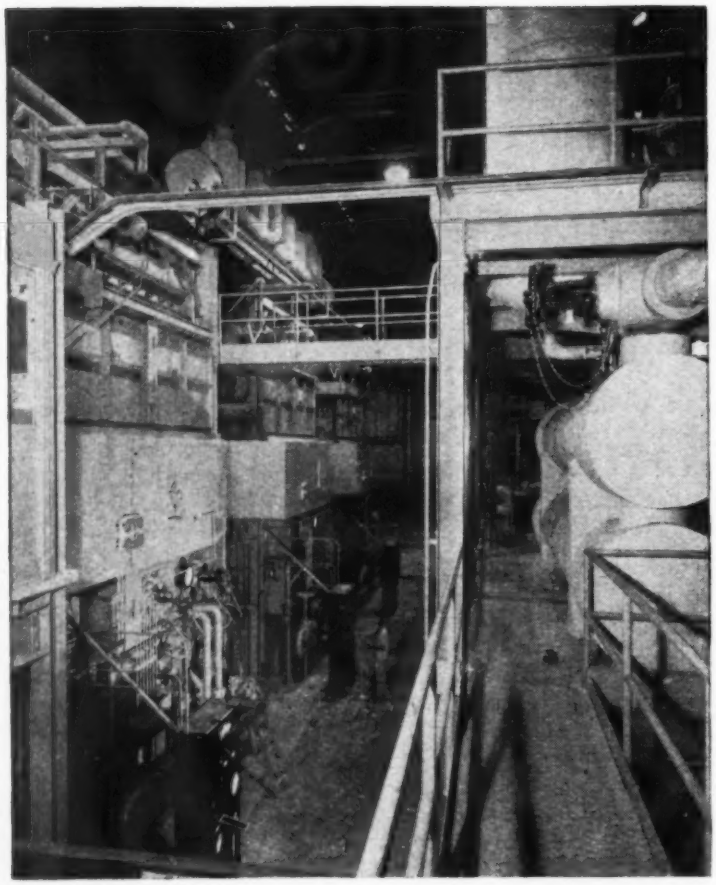
"Gun-Pakt" also means minimum maintenance. One user of 66 "Gun-Pakt" joints kept a record for 14 years—the average cost of materials to service joints was only 65 cents per year per joint! Another user, a large utility, maintains over 100 Yarway "Gun-Pakt" joints at a cost of only $1.50 per month for packing for all joints.

No wonder plants like one of Detroit's largest motor car manufacturers are saying, "We want 'Gun-Pakt' joints and nothing else!"

For the full story on Yarway "Gun-Pakt" Expansion Joints, write for Bulletin EJ-1911.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

GUN-PAKT EXPANSION JOINTS

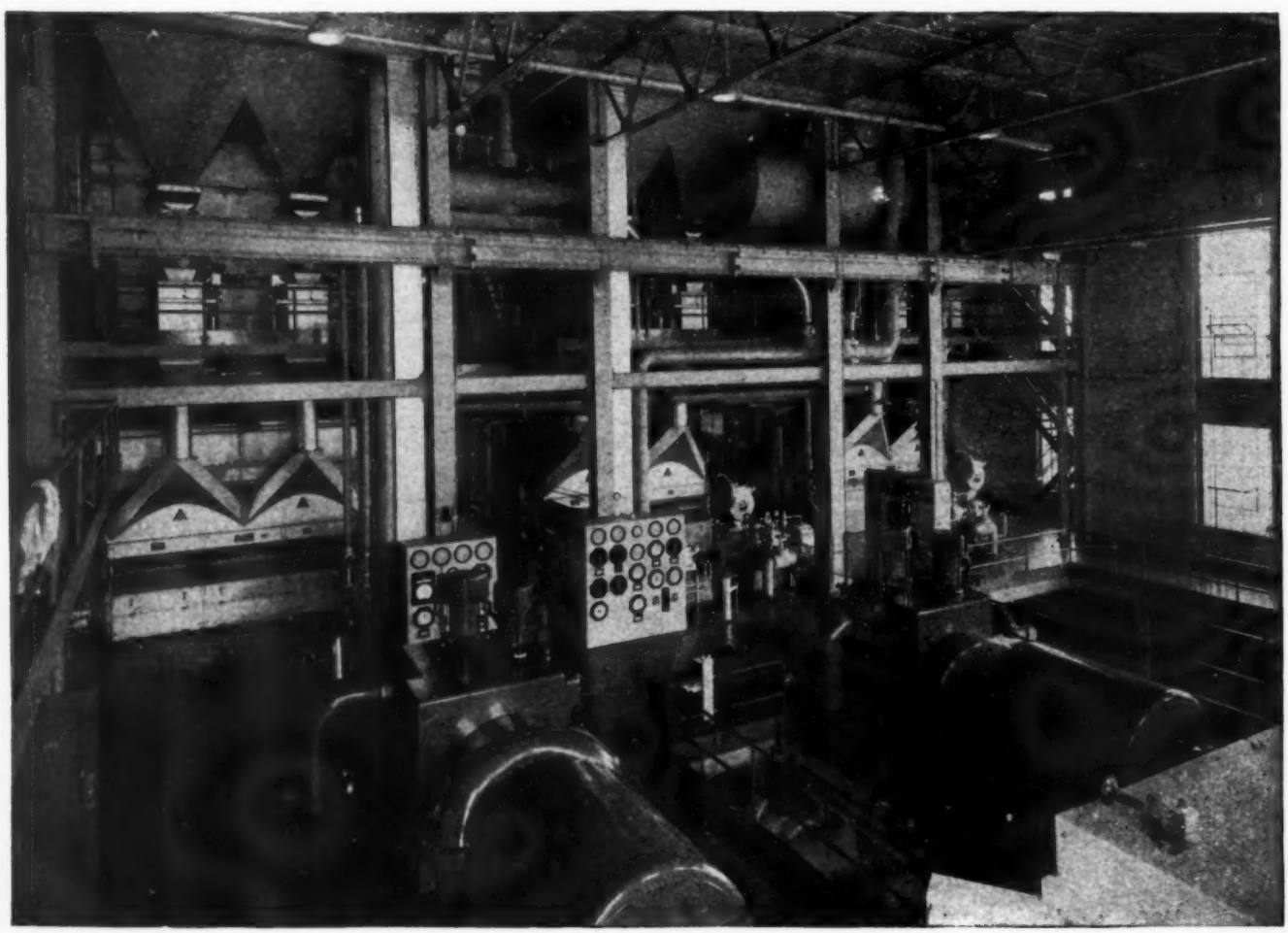


IT TAKES

Left:
Interior view of a new 400,000 lb. steam generating plant suppling steam for a modern industrial plant. Steam is generated in three gas fired boilers which are operated by a Republic automatic combustion control system.

●

Below:
A Republic combustion control system operates the three boilers in this new power plant which supplies all the steam and power for a large university. During the first year of operation this new plant provided heat for 13.0 percent more building space, generated 114.3 percent more electric power but consumed 9.86 percent less fuel.



MORE THAN A GOOD BOILER TO CUT STEAM COSTS!

Low Steam Cost Is Not The Result Of Efficient Boiler Design Alone! It Is Determined By The Degree With Which Your Method Of Boiler Control Takes Full Advantage Of Those Economies Which Have Been "Built In" The Boiler And Its Auxiliaries.

To realize all the financial and operating advantages of modern boilers, they must be closely controlled. They have comparatively small water storage spaces and high combustion rates, hence under some conditions may be very sensitive to load fluctuations. In operating them, therefore, a number of repetitive adjustments must be made frequently and practically simultaneously on several units of auxiliary equipment in order to maintain highest boiler efficiency. The difficulty of making the required repetitive adjustments accurately and synchronously by hand at the individual auxiliaries is obvious.

What is needed, therefore, is a method for making and co-ordinating these adjustments automatically from a centralized control point, at the same time permitting the operator to assume manual control at this point whenever necessary or desirable.

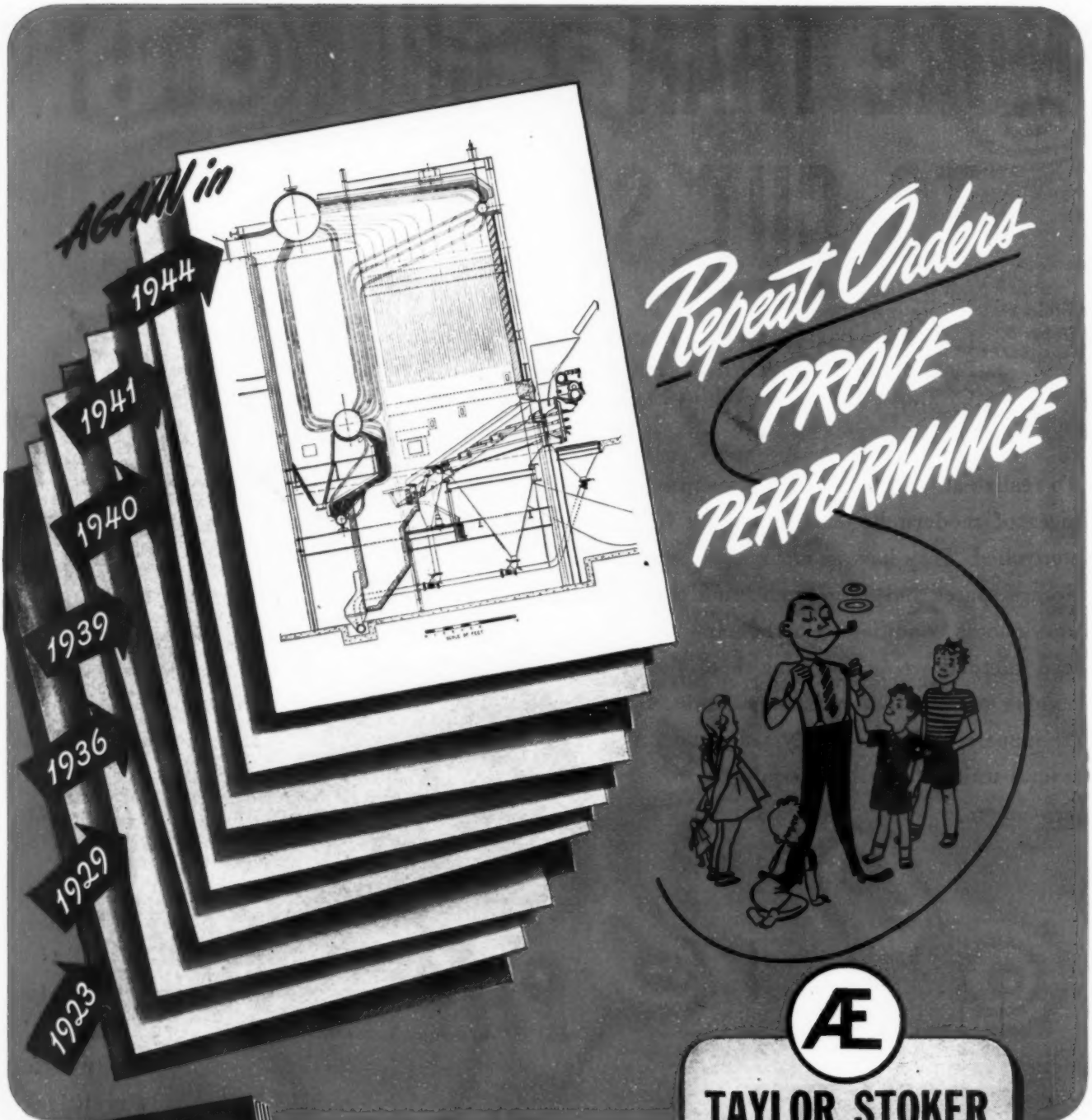
The REPUBLIC combustion control is a unified system controlling simultaneously, in measured quantities and in fixed (adjustable) proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

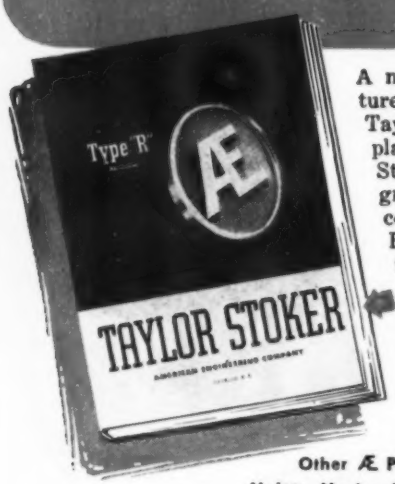
REPUBLIC combustion control systems are designed and built for all sizes of boilers—all types of fuel firing equipment—all load conditions. They fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of every-day operating requirements.

This 94 page data book on automatic combustion control is filled with usable information generally difficult to locate. If you are interested in the advantages of automatic combustion control, write for Data Book No. S-21.

REPUBLIC FLOW METERS CO.

2222 DIVERSEY PKWY. CHICAGO 47, ILL.





A nationally known automobile manufacturer has consistently generated steam with Taylor Stokers since 1923. In the various plants of the company a total of 26 Taylor Stokers are in use. Naturally, when greater capacity was needed recently, this company turned to the new Taylor Type R Stoker which increased steam generation to a total of 1,500,000 lbs. per hour.

GET THE FACTS ON THE IMPROVED TYPE R

This easy-to-read 18 page bulletin will quickly bring you up-to-date on the advantages and improvements in stoker operations as provided by the AE Taylor Stoker. Write for it!

TAYLOR STOKER

AIR-COOLED & WATER-COOLED

The Only Underfeed Stoker with *all* these Features IN COMBINATION!

1. Continuous Self-Sealing Ash Disposal
2. Movable Ash Discharge Plates
3. Smooth-Flow Hydraulic Drive on Rear End
4. Independent Pusher Controls within ⅛ inch
5. Unique Sure-Feed Coal Agitators
6. Silent-Shift Spur Gear Planetary Power Transmission

Other Æ Products: Æ-Perfect Spread Stoker, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVENUE, PHILADELPHIA 25, PA.

perfect – 17 years ago –

STILL BETTER TODAY

Feed this stoker the lowest available grade of coal! Watch it operate perfectly—without clogging—on *any* grade—wet, dry, or partially frozen. This "non-clog" feature is *exclusive* with Perfect Spread.

PERFECT SPREAD STOKER

—with stationary grates, dumping grates or continuous ash discharge—up to 400,000 lbs. of steam per hour.

"Something new has been added!" Today's Perfect Spread Stoker, using the same successful principle of operation which distinguished its 17 years of operation, has been re-designed, streamlined, improved.

It combines features not obtainable in any other stoker. It handles all types of coal—efficiently, economically.

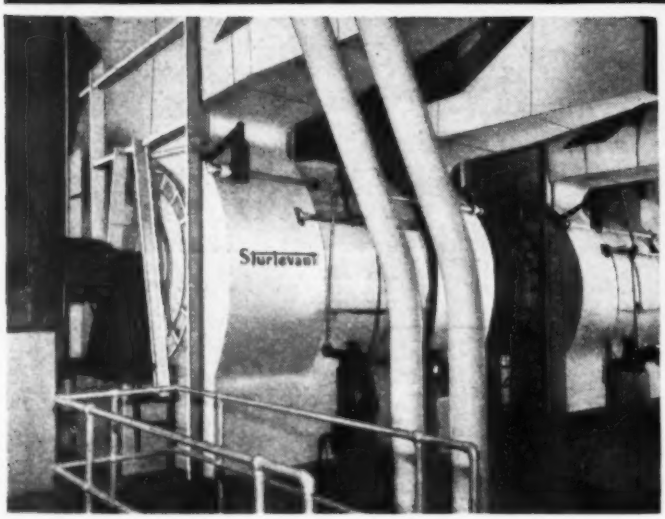
The pleasing, easy-to-clean exterior is indicative of its dependable, quiet operation which brings you both fuel and maintenance savings.

Before you buy any fuel firing equipment, investigate the Perfect Spread Stoker. Write today for descriptive booklet giving *all* the facts!

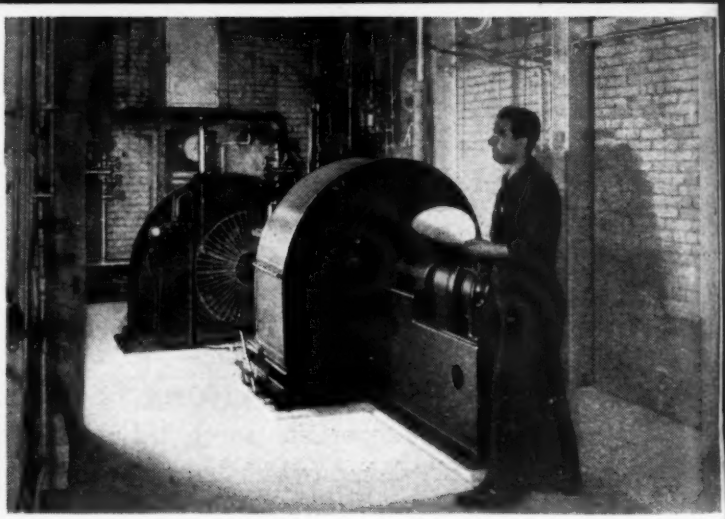
Other Æ Products: Æ Taylor Stokers, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power

AMERICAN ENGINEERING COMPANY
2400 ARAMINGO AVENUE, PHILADELPHIA 25, PENNSYLVANIA

SYMBOL OF RELIABILITY...
THE HUGE MODERN POWER PLANT
at Twin Branch Station of the
Indiana and Michigan Electric Co.

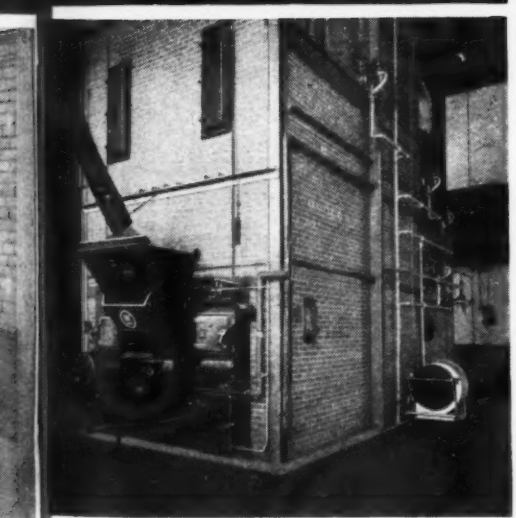


1. Here, inside the Twin Branch Station, these Sturtevant induced draft and fly-ash collector units, each with a capacity of 170,000 cfm, serve one of the world's largest high-pressure boilers. And you can give your small boilers the same dependable equipment, too—like these—



2. Two Design 7 Silentvane fans, rated at 12,500 cfm, with Inlet Vane Control—installed in the boiler room of the Gorham Manufacturing Company, Providence, R. I. Sturtevant fans are doing an outstanding job in thousands of similar installations. Here's another typical example:

HEATING • VENTILATING • AIR CONDITIONING •
DRYING • DUST AND FUME CONTROL • CONVEYING



3. This Silentvane fan, with Inlet Vane Control, supplies mechanical draft for a boiler at the Pequot Mills, Naumkeag Steam Cotton Co., Salem, Mass. Remember—there's no job too large or too small for Sturtevant.

TO THE OPERATOR

OF A SMALL POWER PLANT

WHO WANTS

CENTRAL STATION RELIABILITY

RELIABILITY can be just as important to you as it is to the biggest plants—where continuity of service has become almost proverbial.

One of the chief factors in maintaining maximum output from all boilers —small and large—is the reliability of the mechanical-draft equipment. It's significant, therefore, that you find Sturtevant forced and induced draft fans in so many of the large steam-electric generating stations in this country. That's why you generally associate Sturtevant with the *big jobs.*

But Sturtevant makes smaller fans too —small enough for the moderate or small size plant. And even the smallest Sturtevant fans are essentially scaled-down models of the big units, with the same outstanding reliability, performance and efficiency. From Sturtevant's complete line, you can select everything you need in mechanical draft—Turbovane induced-draft fans, Multivane fans, Silentvane fans, Inlet Vane Control* and induced-draft fly-ash collectors. No matter how small or how large the job, our engineering experts can give you the fan which will best suit your boiler requirements. For further information, write: B. F. Sturtevant Company, *Division of Westinghouse Electric,* Hyde Park, Boston 36, Mass.

*U.S. Patents Nos. 1,846,863; 1,989,413.

Sturtevant
REG U S PAT OFF
Puts Air to Work

B. F. STURTEVANT COMPANY • DIVISION OF
Westinghouse
ELECTRIC

PRECIPITRON

• MECHANICAL DRAFT

. . . OF NEW VU CAPACITY SINCE VJ DAY

Over a period of twelve months following V-J day, VU Units with an aggregate capacity of more than 13,000,000 lb of steam per hr were ordered — more capacity than in any comparable period during the war years when the demand for steam generating equipment reached an "all-time" high. These units have been purchased by many of the nation's leading companies, with a substantial percentage going to the utility field.

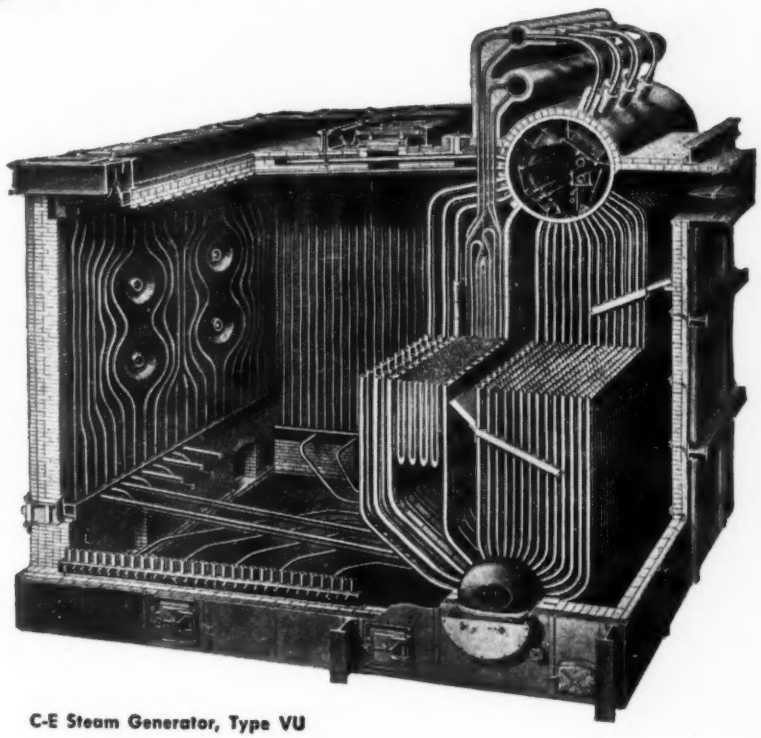
This widespread reflection of confidence in VU design and performance is because the advantages claimed for it (see opposite page) are actually being realized in hundreds of plants. Therefore, it is an easy matter to check and confirm them. They add up to dependable, low-cost steam production as a year-in and year-out proposition. That is what buyers are looking for and that is why more and more of them are ordering VU Units. A-965A

APPLICATION RANGE —Type VU installations cover a range of capacities from 30,000 to 300,000 lbs of steam per hr, with pressures up to 1000 psi and total steam temperatures up to 900 F; adaptable to firing by pulverized coal, oil, gas or any type of stoker.

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

pounds a month!



C-E Steam Generator, Type VU

Consider these 6 Advantages:

1. **Symmetrical Design.** Any longitudinal section through the VU Unit is the same as any other. Each has the same amount of furnace volume, the same evaporative surface, the same superheating surface. Each functions under similarly uniform conditions — same mass flow of gases at practically the same temperatures at any given point. Thus each carries the same amount of water and produces the same amount of steam.

2. **Steam Quality.** All of the most active steam producing tubes enter a baffled area in the drum — see illustration — which discharges well above the waterline and uniformly across the full length of the drum. This arrangement reduces turbulence to a minimum and permits effective utilization of the entire steam release space. Dry steam and a stabilized water level are thus assured even under adverse conditions.

3. **Standardized Construction.** Painstaking refinement of detail is incorporated in each unit at a fraction of the original engineering cost. With standard parts and structural features, the merits of which are confirmed by experience, manufacturing and erection costs are materially reduced. First cost reflects the economy of standardized design and the buyer gains this benefit even before the VU Unit is placed in operation.

4. **Overhead Suspension.** Complete freedom of expansion in all directions is assured because all parts of the unit are suspended from the steel structure which provides the framework for the steel casing. This feature makes ample provision for the effects of temperature changes; it eliminates abnormal mechanical stresses on all pressure parts and explains to a large degree the freedom of the VU Unit from leaky joints.

5. **Adaptable in Application.** The VU Unit may be fired by pulverized coal, oil, gas or any combination of these fuels. It is likewise readily adaptable to firing by any type of stoker. These units are suitable for widely varying requirements of load, pressure and temperature. Inclusion of an interbank or intertube superheater, an air heater or economizer, is easily accomplished as conditions require.

6. **Steel Encased Setting.** The unit setting of shaped tile, refractory and 100% insulation are attractively finished by a permanent outer steel casing. This design, evolved from careful study and experiment, reduces to a minimum heat losses caused by radiation and air infiltration. It tends to eliminate hot spots and helps maintain a uniformly low surface temperature throughout the steel casing. Maintenance is negligible.

ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

Diet Control
for a million-dollar appetite

Give your slide rule a bit of exercise the next time you consider a boiler installation by figuring out just how many dollars' worth of fuel that boiler will consume during its useful life. You will find that even a moderate sized boiler has a million-dollar appetite.

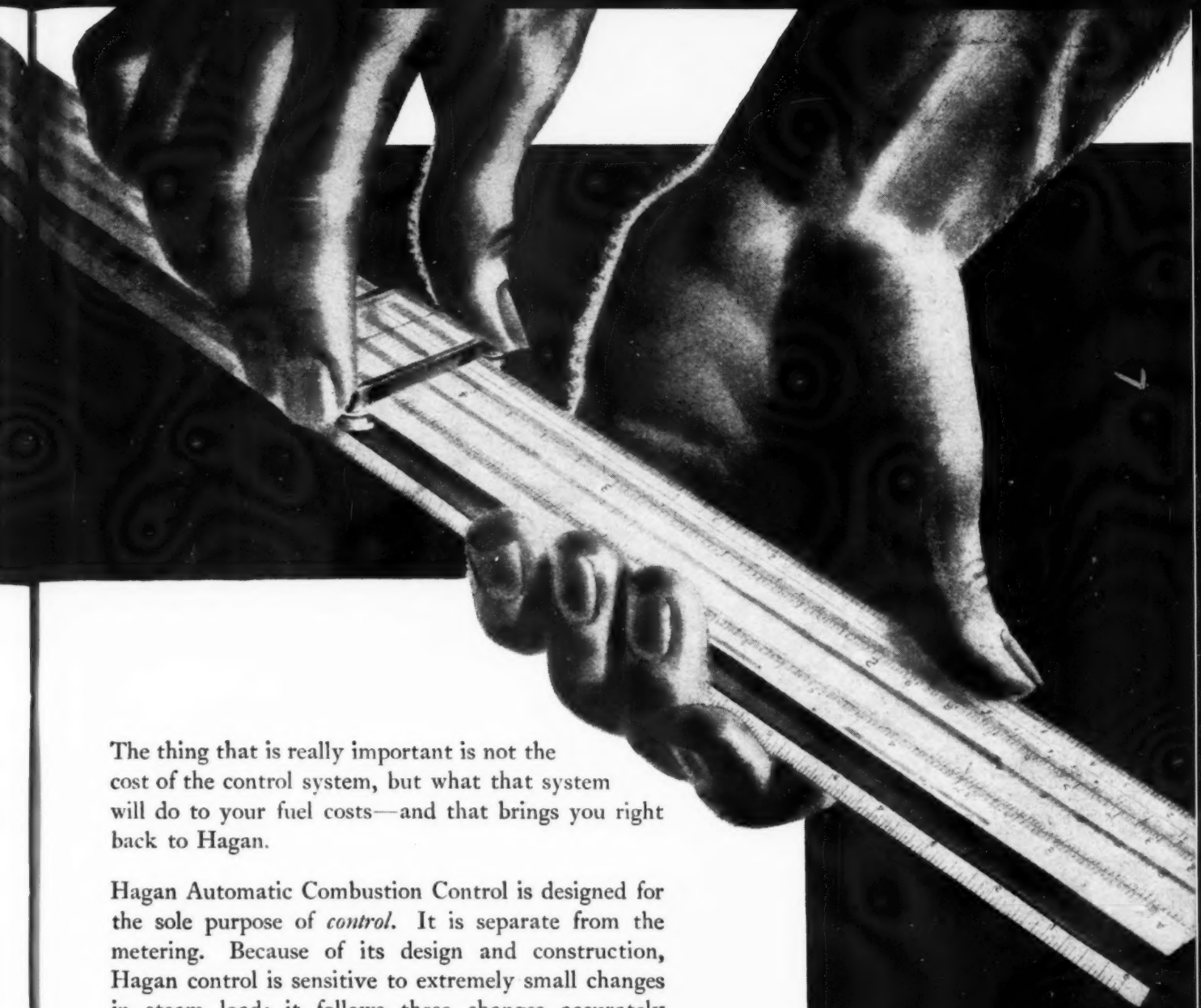
You will equip that boiler with Automatic Combustion Control, of course, but you may be undecided about which control to install. The first cost of Hagan Control is usually a bit higher, and you may find yourself thinking that you can save a few dollars by using something cheaper.

If so, just keep that slide rule working and figure out how small that saving is in comparison with the fuel cost—or, for that matter, how small the cost of the whole control system is.

HAGAN
HALL
BUROMIN
CALGON

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader



The thing that is really important is not the cost of the control system, but what that system will do to your fuel costs—and that brings you right back to Hagan.

Hagan Automatic Combustion Control is designed for the sole purpose of *control*. It is separate from the metering. Because of its design and construction, Hagan control is sensitive to extremely small changes in steam load; it follows these changes accurately and instantly. The steam flow-air flow chart of any Hagan-equipped boiler is evidence of the inherent stability of the Hagan system.

Hagan equipment lasts as long as the boiler—and gives you dependable, trouble-free service as long as it lasts. Our engineers are at your service.

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

Measure

Protection
OF SMALL MOTORS

in terms of

Production

and you'll install

BUSS FUSETRONS

throughout your electrical system to protect all of them

Here's Proof . . .

Fusetrons Eliminate Average of Two Motor Burnouts per Month on Fan Motors.

"Steam is exhausted from the rooms where we empty our bone char by exhaust fans of two types—a 36 inch fan operated by ½ h. p. motor and a 24 inch fan operated by ¼ h. p. 3 phase—220 volt motor. The grilles or louvers open to the northeast right over the Delaware River. High winds will therefore sometimes stall the motors and in a very severe storm, the wind may even reverse the direction of the motor while it is running. Also, the starting current is increased greatly when the blades are revolving in the opposite direction, due to high wind.

"Prior to 1942, at least two of these fan motors were replaced every month, due to burnout. Replacement was very difficult and expensive due to the fact that the fans are mounted right below the ceiling and above steam pipes.

"Early in the summer of 1942 we installed 8 ampere Fusetrons for the ½ h. p. motors and 6¼ ampere Fusetrons for the ¼ h. p. motors. Up to August of 1945 we had not had to replace a single fan motor protected by Fusetrons."

David J. Coles, Electrical Engineer,
McCahan Sugar Refining Co.,
Philadelphia, Pa.

Motor Repair Co. Won't Guarantee Motor Rewind Job Unless Motor is Protected by Fusetrons

"We have found Fusetrons and Fustats (Fusetrons with a tamper resisting base for 125v. circuits) so satisfactory for the protection of small motors that for a number of years we have refused to give a warranty with a rewound motor job unless the owner installed a Fusetron or Fustat to protect the motor. We saw to it that the size used would give burnout protection.

"We are convinced that this policy of installing a Fusetron or Fustat to protect all rewound motors has saved us a lot of unjustified complaints—and no one knows how much expense taking care of motors within the warranty period."

A. H. Wolf, Superintendent
of Motor Repair Dept.
Swanson-Nunn Electric Co.
Evansville, Ind.

BUSS FUSETRONS

GET SMALL MOTOR PROTECTION
Simply and Inexpensively

Burnout of motors from lack of oil, worn bearings, tight belt, overloading—or anything that causes a dangerous excess of current through the motor—can, on normal installations, be prevented by Fusetrons.

Just install a Fusetron of motor-running protection size, anywhere in the circuit to handle only the motor current. *That's All.*

If motor is on a separate circuit, install the Fusetron in the switch or panelboard. Then the motor as well as the circuit wiring is protected.

If the motor is on a general use circuit or a circuit feeding more than one motor, protect each motor individually by installing a switch or a fuse block with the proper size Fusetron. *It Is As Simple As That.*

Protect Against Cost of Replacing a Motor—and Against Production or Operating Losses

When pumps, fans, air compressors, blowers, conveyors, mixers, stokers, oil burners, grinders —or any of the hundreds of other circuits on which small motors are used—are out of service because of a motor burnout the losses incurred generally make the cost of Fusetron protection seem mighty small.

You not only have the cost and trouble of removing and replacing the destroyed motor—but all the time the motor is down, production or operating losses pile up.

It's guarding against these double losses that makes it pay you so well, to go to the little expense and trouble necessary to install Fusetrons for the protection of all small motors used throughout your plant or building.

FUSETRONS GIVE MANY OTHER KINDS OF PROTECTION HERETOFORE NOT AVAILABLE

Fusetrons do everything fuses do, as is confirmed by the Underwriters' Laboratories' Label, and in addition . . .

★ Provide simplest way to stop burnouts from single phasing. ★ Entirely wipe out needless blows caused by motor starting currents or other harmless overloads. ★ Give thermal protection to panelboards and switches. ★ Prevent needless blows caused by heating in panels and switches. ★ Permit use of larger motor or adding more motors on circuit without installing larger switch or panel. ★ On new installations proper size switches and panels can be used instead of oversize. Protect motors against burnout. ★ Give double burnout protection to large motors.

What is the FUSETRON?

The Fusetron is a DUAL element device—a Fuse to which is added a Thermal cutout.

The result is a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriter's Laboratory approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses, Fusetrons fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere in both 250 and 600 volt types. Also in tamper-resisting type (Fustats) for 125 volt circuits.

Their cost is surprisingly low.

Get All the Facts

Get Better Protection—Send the Coupon Now

Even one lost, hard-to-replace motor, or one needless shutdown or destroyed panel may cost you far more than replacing every fuse with a FUSETRON.

Don't risk such losses—protect your production schedules by changing over your entire electrical system to FUSETRONS.

BUSSMANN MFG. COMPANY
University at Jefferson • St. Louis 7, Mo.
(Division McGraw Electric Co.)

Sold through Wholesalers

BUSSMANN MFG. CO., University at Jefferson 1146
St. Louis 7, Mo. *(Division McGraw Electric Co.)*

Please send me complete facts about BUSS Fusetrons.

Name_____

Title_____

Company_____

Address_____

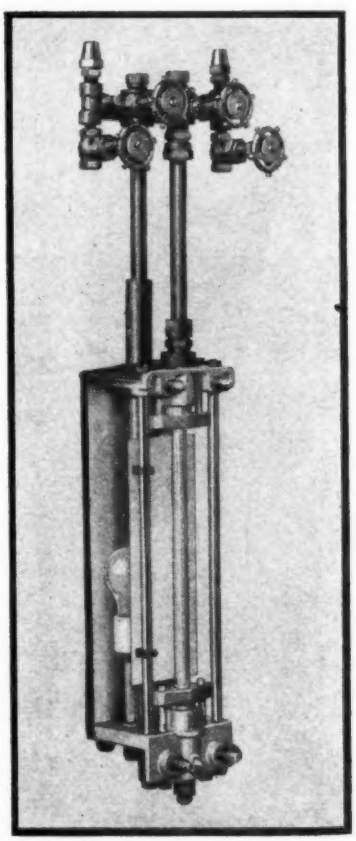
City_____ State_____

Newly Styled— Newly Engineered

The new model E-32 EYE-HYE for pressures to 400 lbs.

Simplicity of Operation
Rugged Construction
Easy to Install
Cannot be Mis-adjusted

Newly engineered, the EYE-HYE is more compact than previous models —has added features of special value. Cover is removed by unscrewing four acorn nuts . . . making interior easily accessible for replacing lamp or cleaning the gage. The new case is water-proof, protecting illuminating element from any overhead dripping. Handsome cover plate bolts to face of panel board, or entire unit is bolted to girder or wall through mounting flanges at back.



EYE-HYE with face plate and cover removed.

Since 1884

Reliance

Reliance EYE-HYE gives you full assurance of safe, accurate boiler water level reading wherever you want it

You probably know the EYE-HYE, *through observation or through actual use. Power engineers everywhere have watched the progress of this remote reading gage — a new idea ten years ago — now widely used in both stationary and marine power plants.*

YOUR high-on-the-boiler water gages are brought down to eye level—your supervision of water levels is more confident—with this simple, positive, fool-proof device. Water level image shows bright and clear, in green indicating fluid (illuminated), the EYE-HYE window unit placed prominently on panel board or other convenient mounting. It reads like the water gage on the drum—a column of liquid. Connections are simple—two lines of flexible tubing easily installed to constant head reservoir at the drum (an accessory device supplied with EYE-HYE).

EYE-HYE is now restyled—re-engineered. First new model announced, E-32, is adaptable to pressures up to 400 lbs. Other new models will soon be ready, for pressures to 2000 lbs. Today's EYE-HYE is more compact, has greater pressure range per model, shows modern design. Its calibration is fixed for your particular requirement; cannot be tampered with in service.

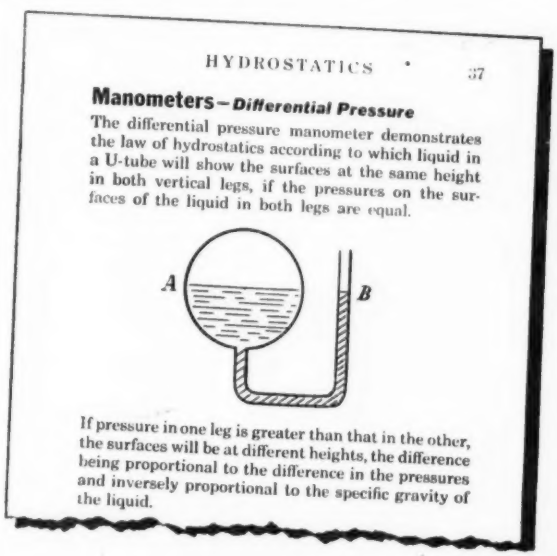
Plan to add EYE-HYEs to your boiler equipment, for the greater efficiency of remote water level supervision guaranteed by simple, hydrostatic action. Write for latest information.

EYE-HYE's simplicity guarantees accurate boiler water level reading

It's easy to understand the simple operation of the EYE-HYE. Operating on the principle of the U-tube differential pressure gage or manometer, EYE-HYE itself forms the bottom of the U, while the flexible tubes connecting it to the boiler drum complete the two legs. That's all there is to it.

Unitemp, the special Reliance condensing reservoir, maintains even temperature in both hydrostatic legs—assures constant accuracy of the EYE-HYE reading.

The Reliance special indicating fluid, Vizzene, will not mix with water—always maintains its place as pressure in the legs pushes it back and forth in exact relation to rise and fall of the boiler water level.


HYDROSTATICS • 37

Manometers—*Differential Pressure*

The differential pressure manometer demonstrates the law of hydrostatics according to which liquid in a U-tube will show the surfaces at the same height in both vertical legs, if the pressures on the surfaces of the liquid in both legs are equal.

If pressure in one leg is greater than that in the other, the surfaces will be at different heights, the difference being proportional to the difference in the pressures and inversely proportional to the specific gravity of the liquid.

BOILER SAFETY DEVICES

THE RELIANCE GAUGE COLUMN CO.
5902 Carnegie Ave., Cleveland 3, Ohio

A FOSTER WHEELER FIRST

EXPANDED TUBE CONDENSERS *for purest feed water*

Expanded tube condenser design, introduced 20 years ago by Foster Wheeler and considered a highlight of condenser development, is used by modern condenser manufacturers. The design completely eliminates leakage of circulating water into the condensate.

Condensate contamination became a major problem with the advent of higher pressure and temperature steam generators. Slight impurity of feed water, unnoticed for years in plants operating at 300 or 400 psi, quickly forms heavy scale at higher pressures and temperatures. Modern steam generators need almost chemically pure feed water — purer than drinking water.

Foster Wheeler anticipated this problem by designing the first expanded tube condenser for stationary power plants.

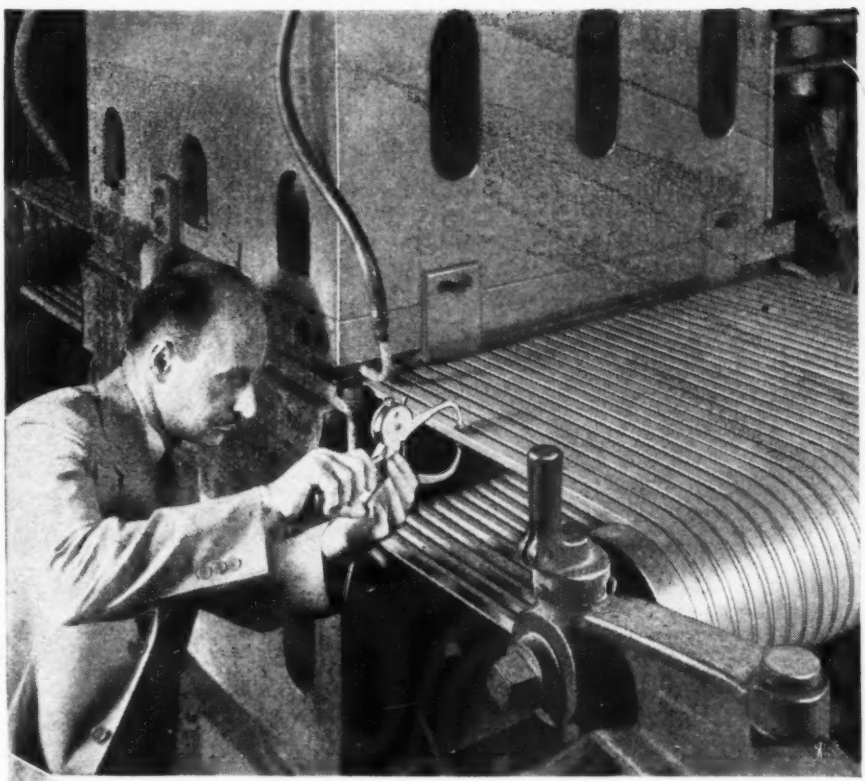
The condensers illustrated, first practical application of this design, were built in 1925 by Foster Wheeler for the Trinidad, Texas, station of the Texas Power & Light Company. Test data proved that expanded tube condensers provide feed water purer than all previous types.

Foster Wheeler offers industry practical engineering ability and experience plus foresight necessary for progress.

Foster Wheeler Corporation · 165 Broadway, N.Y.6, N.Y.

FOSTER WHEELER

PUTTING ON THE Pressure

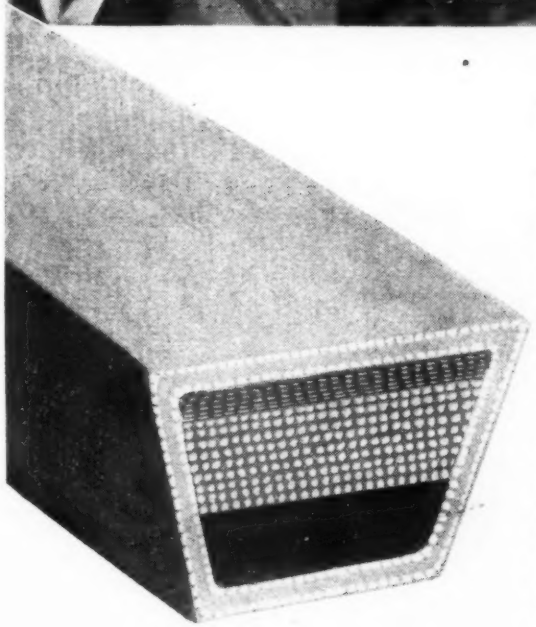


to give you tougher, truer-running TEXROPE V-BELTS

PRECISION curing in these powerful pressure molds gives TEXROPE Super-7 V-Belts their toughness and accuracy of section.

The molds themselves are machined to precision tolerances. Heat, pressure and curing time are accurately controlled. Skilled operators check every step of the process.

This careful curing combines strong, hard-twisted cords, rugged two-ply cover stock and shock-absorbing rubber into BETTER V-BELTS to drive your machines —uniform, long-lasting, smooth-running.



Heat-Resisting Super-7
Stands temperatures up to 180°. The TEXROPE V-Belt for most drives.

Oil-Resisting Super-7
Neoprene cover protects core against moderately oily or greasy conditions.

Oil-Proof Super-7
Made of Neoprene throughout. Use it when the belt must swim in oil.

Static-Resisting Super-7
Recommended where explosion hazard exists. Static-conducting element throughout cover won't wear off.

ONE CALL — FOR ALL V-BELT DRIVE NEEDS

Your nearest Allis-Chalmers office or dealer offers COMPLETE V-Belt Drive service: Super-7 V-Belts in all types and sizes — full range of standard, "Magic-Grip" and Vari-Pitch sheaves — Speed changers — experienced engineering aid by the originators of industry's Multiple V-Belt Drive. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 2101

ALLIS-CHALMERS
One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

TEXROPE V-BELT DRIVES

low cost steam CONTRIBUTES TO

BRUCE J. CARL
MAYOR

D. ELROW CRANE
CHIEF ENGINEER

ERNEST J. RAY
SECRETARY

City of Columbia
Water and Light Department
Columbia, Missouri

FOR THE PEOPLE
BY THE PEOPLE

MAXIMUM SERVICE
MINIMUM RATES

September 24, 1946

Hoffman Combustion Engineering Co.
710 Marquette Building
Detroit, Michigan

Gentlemen:

In 1938 we purchased our first FIRITE spreader type stoker from you to install under a Springfield 60,000 pound per hour steam generator. Since the installation it has seen service better than 90% of the time.

The rest of the plant consisted of five (5) other boilers which were being fired with chain grate stokers when the above mentioned purchase was made.

I might add that we were so well pleased with the first installation that we purchased two (2) additional FIRITE spreader type stokers, one of which is in the process of installation at this time and the third installation to be completed the first half of 1947.

I can heartily recommend this equipment to be used with any steam generator at any location. Come down and look it over for yourself.

Yours very truly,

D. Elrow Crane

D. Elrow Crane,
Superintendent

DEC/mlh

The Educational Center of Missouri

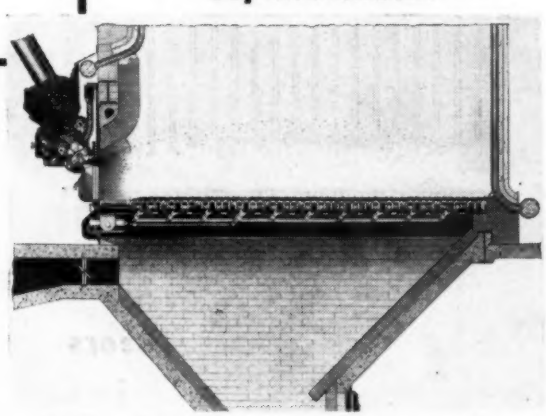
CITY OF COLUMBIA Missouri in seven years increases output 130% to 20,640,000 KWH at a coal increase of only 16%

D. ELROW CRANE
Superintendent

July 27, 1946
1¼" x 0 Washed Screenings As Fired

Moisture	9.26	Ash	7.37
Vol M	36.95	Sul	3.28
F. C.	46.42	B. T. U.	11,617

Ash Fusion 1900-2000°F



Power dumping grates under Boilers No. 1 and 2

HOFFMAN COMBUSTION

WORKS AT: FAIRMONT, WEST VIRGINIA
DETROIT, MICHIGAN

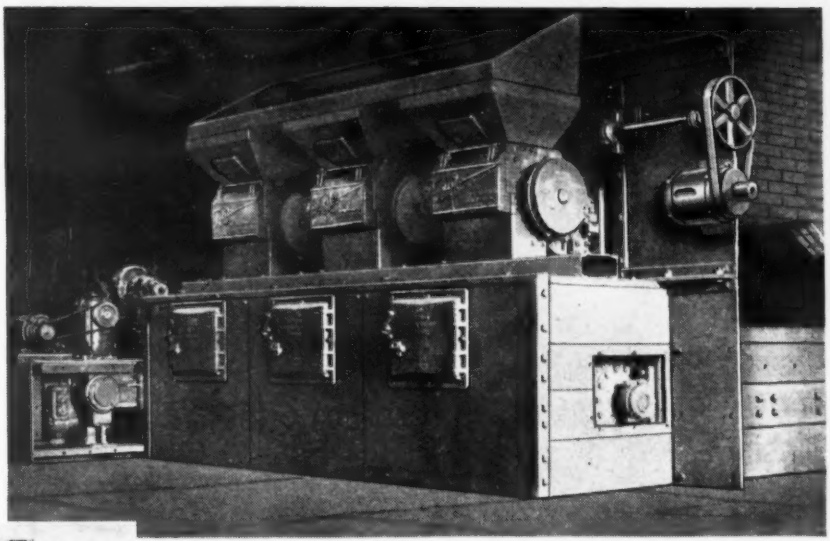
EARNING POWER of municipal plant

HOFFMAN

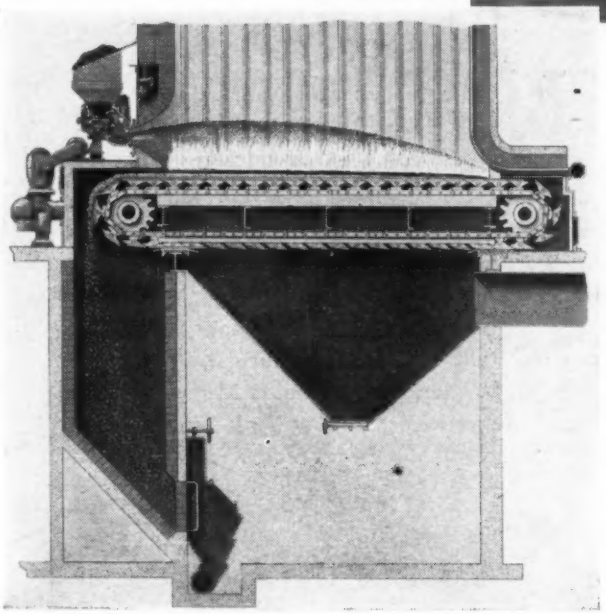
Firite SPREADER

STOKERS

with power dumping grates
and
continuous discharge grates



3/4 elevation Type 3C-CAD Hoffman Firite Stoker



Continuous Ash Discharge grates under Boiler No. 3

Burns & McDonnell Engineering Co.

Consulting Engineers

Kansas City, Missouri

According to the July-August issue of Mid-West Municipal Utilities Publication, the City Water and Light Plant of Columbia, Missouri, in 1945 contributed to the total general revenue of the City of Columbia the sum of $92,106.35, plus an additional $10,000.00 special appropriation to the City Street Maintenance fund; and, in addition, "loaned" $27,500.00 to the Municipal Airport fund.

The total general revenue from all sources of the City of Columbia, Missouri, for 1945 was $212,279.67.

After making the above contributions for general revenue purposes, the Water and Light Plant purchased another $50,000 in Government bonds, and has a total of $584,650.00 in bonds and a cash reserve of $263,083.99 to use on maintenance and expansion program, which ultimately will involve better than $1,000,000.00.

ENGINEERING COMPANY

OFFICES: Marquette Building, Detroit, Mich. Bell Building, Chicago, Illinois
154 Nassau Street, New York City Twenty-Two Marietta Bldg., Atlanta, Ga.

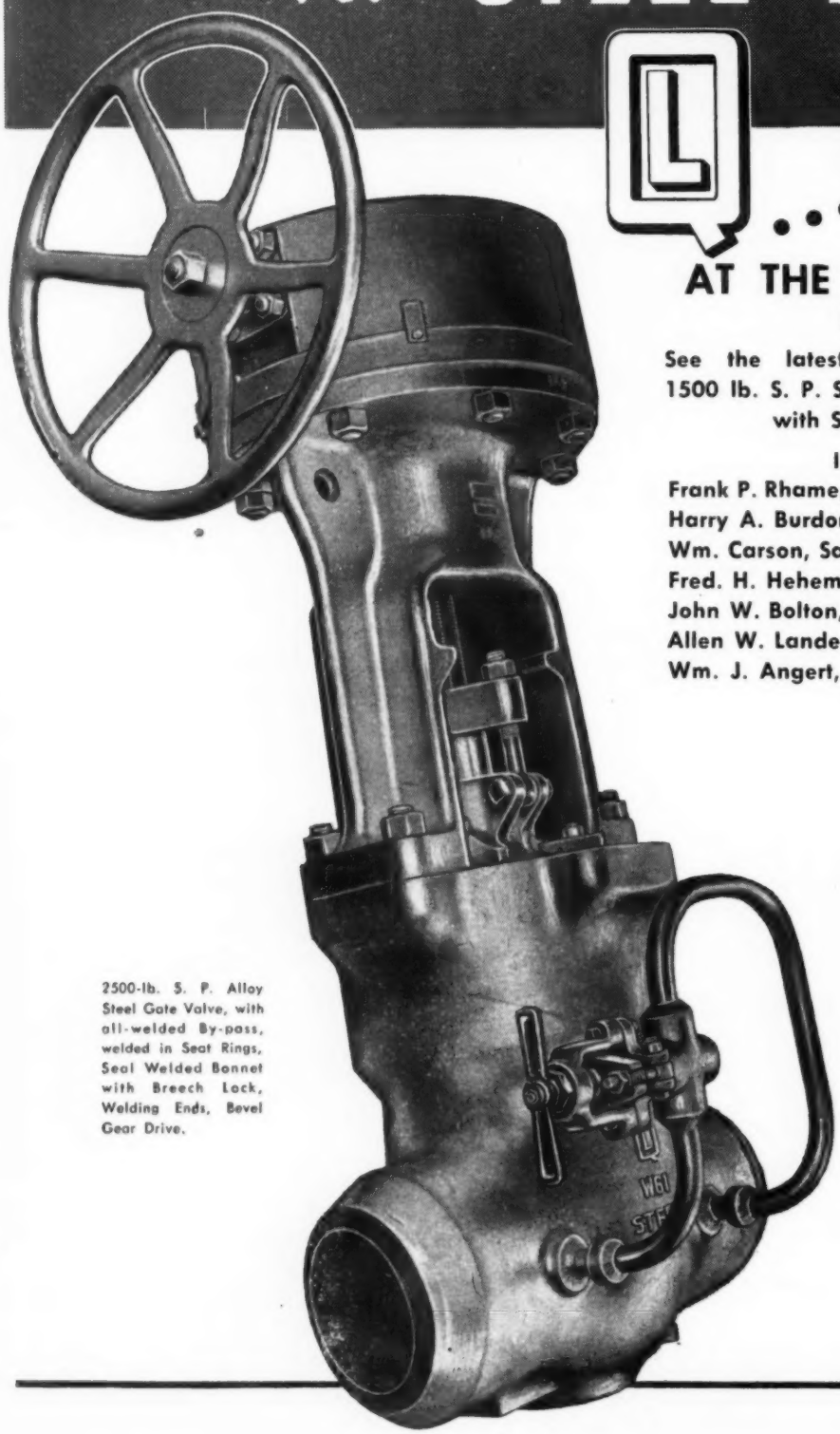
Look to LUNKENHEIMER *for* STEEL VALVES

...This Mark

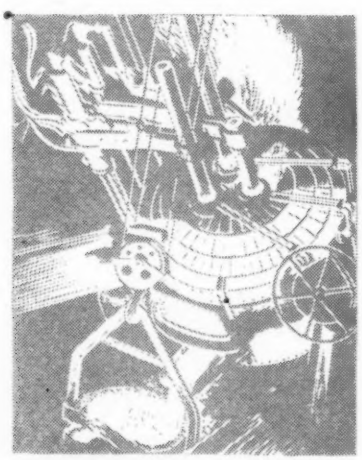
AT THE POWER SHOW
BOOTH 52

See the latest Lunkenheimer design of 1500 lb. S. P. Steel Breech Lock Gate Valve with Seal Welded Bonnet

In attendance:
Frank P. Rhame, President;
Harry A. Burdorf, V.P. in Charge of Sales;
Wm. Carson, Sales Engineer;
Fred. H. Hehemann, Chief Engineer;
John W. Bolton, Chief Metallurgist;
Allen W. Lander, Eastern Sales Mgr.;
Wm. J. Angert, Mgr., New York Branch



2500-lb. S. P. Alloy Steel Gate Valve, with all-welded By-pass, welded in Seat Rings, Seal Welded Bonnet with Breech Lock, Welding Ends, Bevel Gear Drive.



ELECTRIC STEEL FURNACES

Only laboratory O.K.'d metals are used. Heating and pouring temperatures are carefully controlled. Every scientific aid is used to produce fine castings in our own steel foundries.

is your assurance of Highest Quality

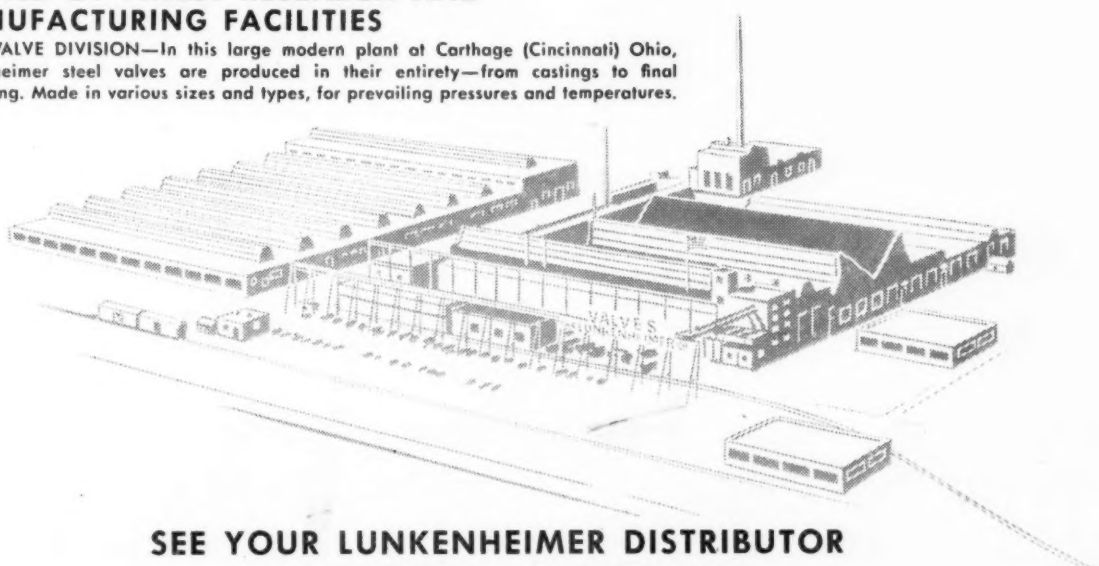
● Long skilled in the manufacture of valves and ever responsive to industry's needs, Lunkenheimer pioneered in the development of Steel Valves.

With the application of higher and higher temperatures and pressures, operating conditions became increasingly severe. Lunkenheimer was ready with valves fabricated from materials that met the most exacting requirements.

And as new problems arise, Lunkenheimer metallurgical research, engineering knowledge and specialized manufacturing facilities can be depended upon to aid in their satisfactory solution.

BACKED BY FINEST RESEARCH AND MANUFACTURING FACILITIES

STEEL VALVE DIVISION—In this large modern plant at Carthage (Cincinnati) Ohio, Lunkenheimer steel valves are produced in their entirety—from castings to final machining. Made in various sizes and types, for prevailing pressures and temperatures.



SEE YOUR LUNKENHEIMER DISTRIBUTOR FOR BETTER VALVE SERVICE

Lunkenheimer manufactures a complete line of Bronze, Iron, and Steel Valves, Boiler Mountings, Lubricating Devices and Air Devices. Available from Distributors located in all industrial centers. There is one near you, fully equipped to assist with your (MRO) maintenance, repair, and operating problems.

THE LUNKENHEIMER CO., Cincinnati 14, Ohio, U.S.A.

New York 13, Chicago 6, Boston 10, Philadelphia 7
Export Dept., 318-322 Hudson St., New York 13

TURBINE TROUBLE DISAP

A large paper mill was having trouble from time to time with accumulation of paper pulp on the turbine blades.

The Hall engineer found no evidence to show that pulp could get to the boilers, and even if that had been possible, it was not conceivable that paper pulp could carry over with the steam in any amount.

Boiler water contamination was, therefore, eliminated as a possible source of the trouble —*but Hall engineers don't stop merely because they have shown that the boiler water conditioning has been satisfactory.* The engineer continued his check-up until he discovered that the drain pipe from the turbine seal ended in a drain ditch. Usually the ditch was practically dry but during the periods when the paper machines were being washed, paper pulp was being discharged into this ditch. At such times the level of the water in the ditch was above the open end of the drain pipe.

The Hall engineer pointed out that if the turbine was shut down at a time when the ditch happened to be full, the vacuum created by the condensing steam would suck pulp out of the ditch into the turbine through the turbine seal. The drain line was broken at a union and the inner surface of the pipe was found to be coated with paper pulp—clear evidence that it was getting to the turbine in this way.

The cure was simple—a quarter-inch hole drilled in the drain-pipe above high-water mark in the ditch, to prevent the formation of a vacuum in the drain pipe. When this was done, there was no further trouble.

"Trouble shooting" of this kind is typical of the work of Hall engineers. Their primary task is to prevent trouble, but when trouble does occur they are prepared to trace it to its source and show how it can be eliminated. Our records show that time and again troubles encountered in plants that have Hall service are due to factors other than water.

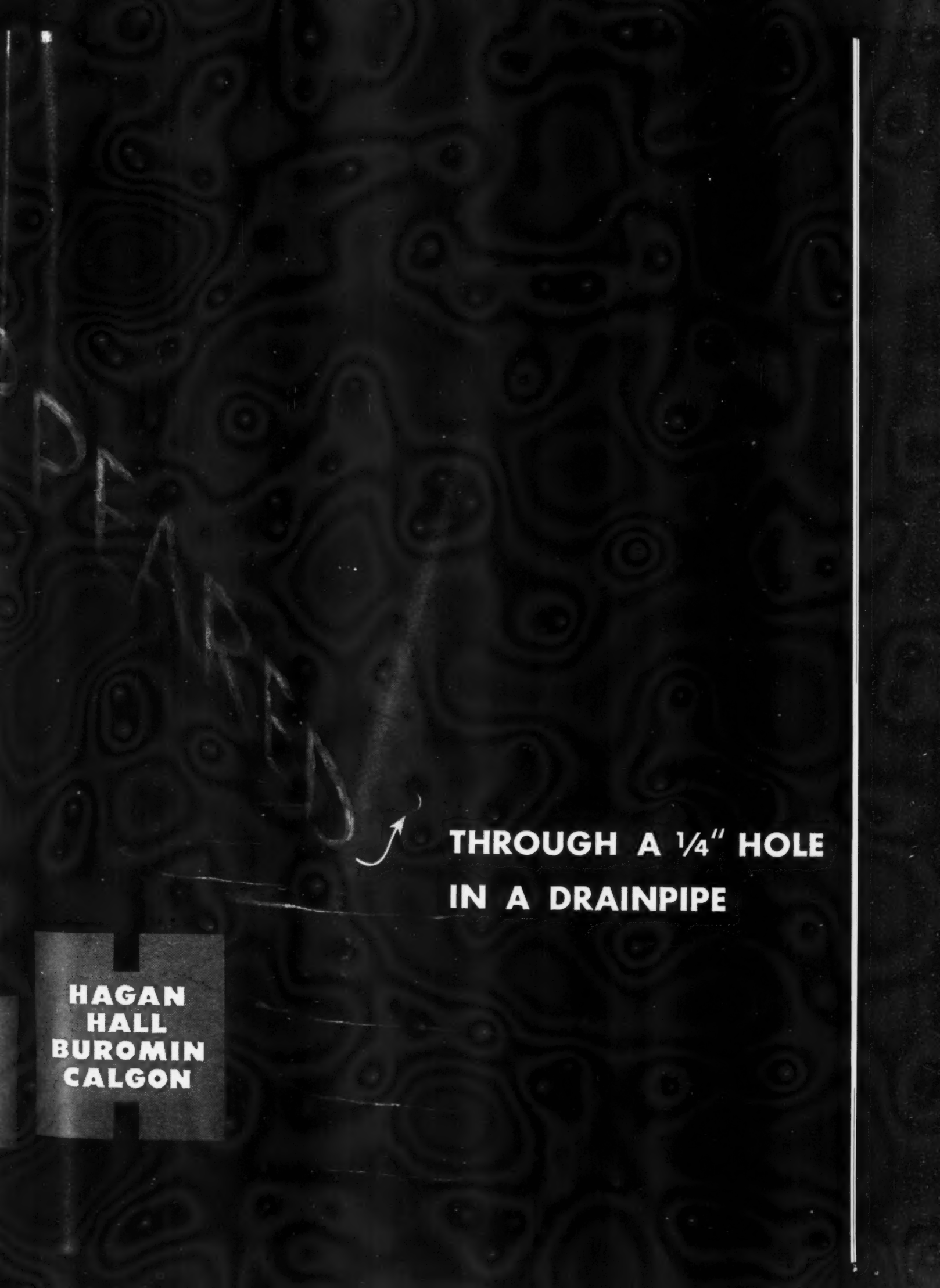
Every plant that generates its own steam can profitably use Hall Service.

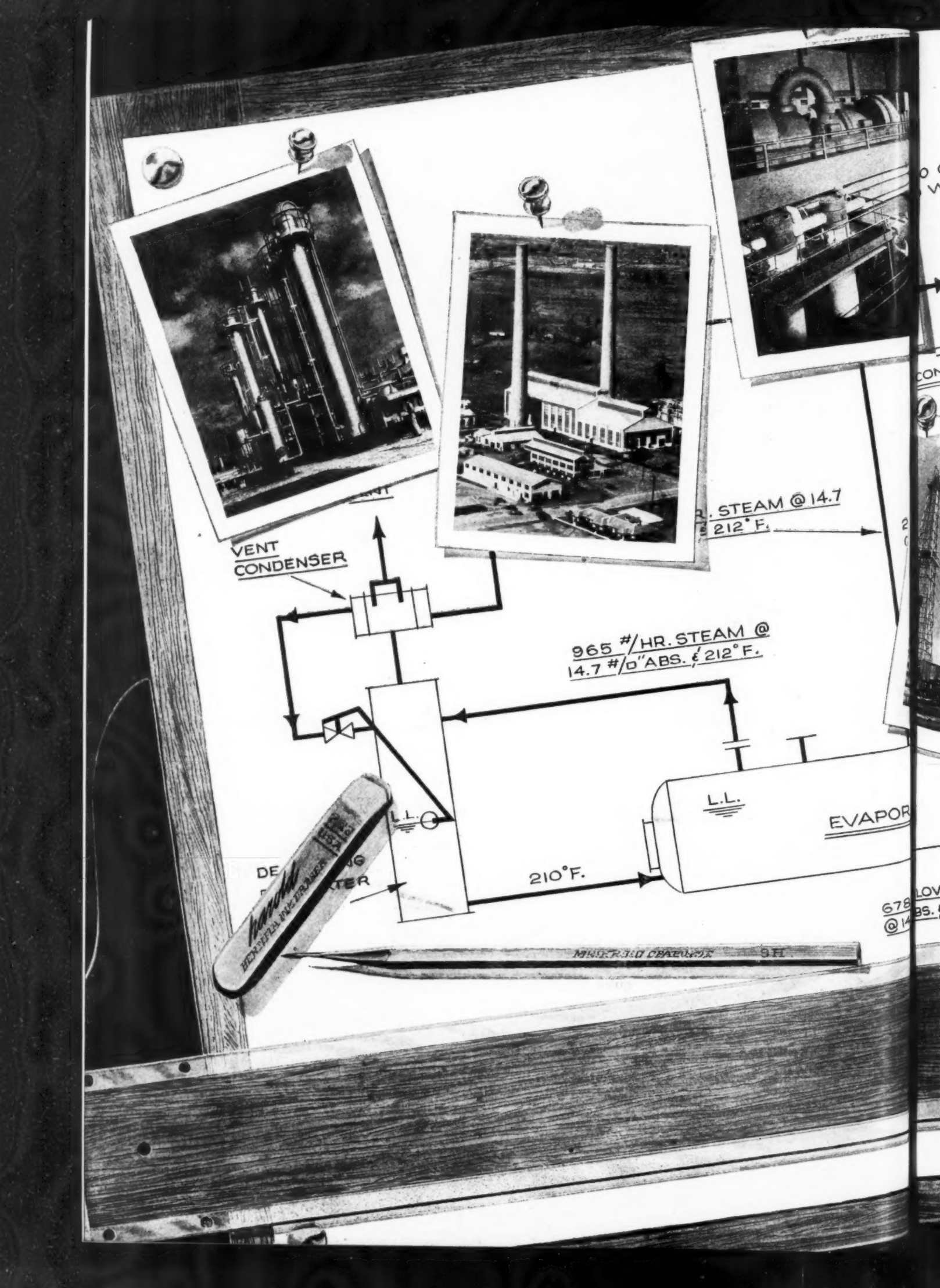
We will be glad to send you full information.

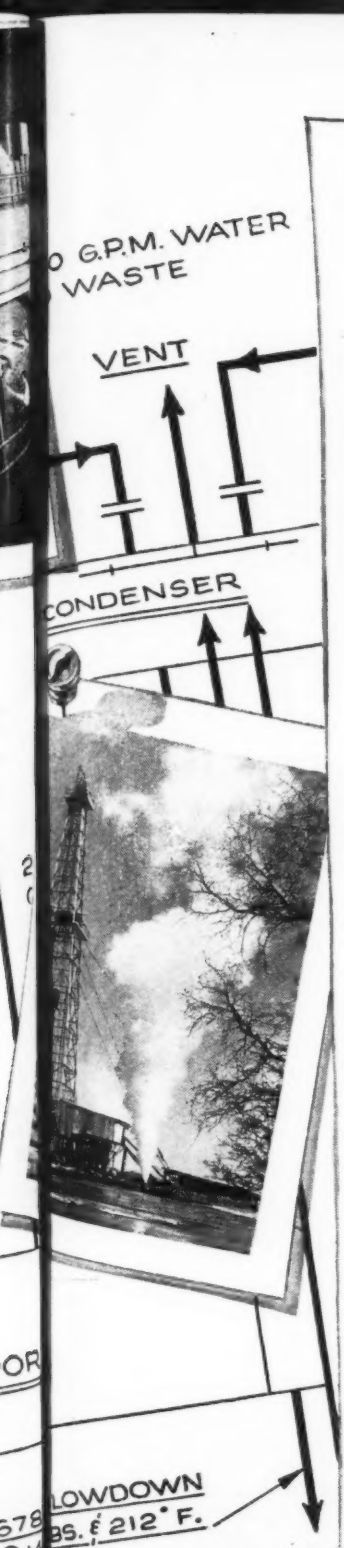
HALL SYSTEM *of Boiler Water Conditioning*

HALL LABORATORIES, INC. · HAGAN BUILDING · PITTSBURGH 30, PENNSYLVANIA

A subsidiary of Hagan Corporation


THROUGH A 1/4" HOLE
IN A DRAINPIPE
HAGAN
HALL
BUROMIN
CALGON


VENT
CONDENSER
965 #/HR. STEAM @
14.7 #/0" ABS. & 212° F.
STEAM @ 14.7
212° F.
L.L.
L.L.
EVAPOR
210°F.
DE
TER
678
@14
MINERAL OIL CORPORATION
9H



ANOTHER ALCO "FIRST"... A NEW "PACKAGE" UNIT FOR BETTER

Boiler Feed and Make-Up Water Purification

A FEW MONTHS ago ALCO announced its new line of ALCO Evaporators, greatly improving evaporator practice in efficiency, operation, and maintenance.

Now ALCO comes forward again with a new *complete boiler feed and make-up water purification "package" unit* capable of keeping boiler feed water free from impurities with an unprecedented combination of efficiency, convenience in operation and maintenance, and economy of steam, water, and capital cost. This is another example of ALCO initiative in producing new ideas and better equipment.

With this equipment, total impurities in the water entering the boiler will never exceed five ppm, of which not more than two ppm will be salt solids, and not more than three ppm will be oil.

The entire apparatus will be assembled on a single base for average industrial sizes and shipped as a unit for quick and easy installation.

With this equipment a maximum of steam will be recovered, a maximum of impurities removed, and a minimum of raw water (also purified) will be required.

This equipment will function efficiently within a wide range of impurity content and will be found especially valuable for all applications where water is scarce or its impurity troublesome.

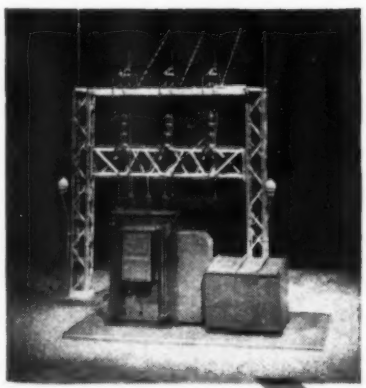
ALCO engineers are ready to specify or discuss ALCO equipment of this type to meet your requirements of capacity, water characteristics, or other operating conditions. Please address American Locomotive Company, 30 Church Street, New York 8, N. Y. Manufactured and sold in Canada by the Montreal Locomotive Works Ltd. In the British Empire by Daniel Adamson & Co. Ltd.

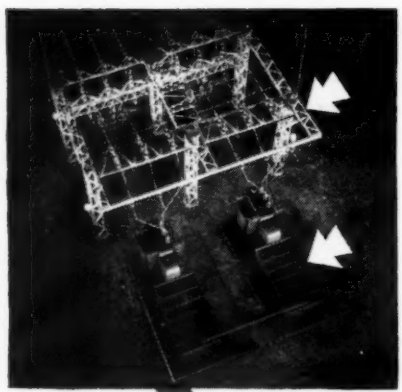
American Locomotive

Alco

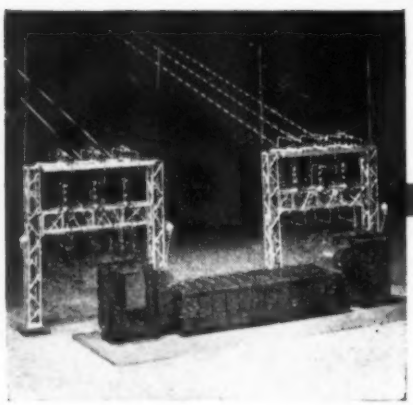
THE MARK OF MODERN ENGINEERING

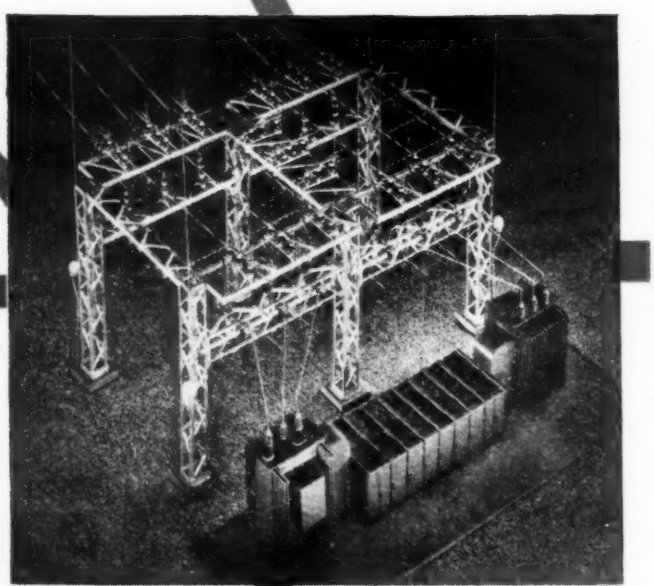
NOW! G-E announces *Package*

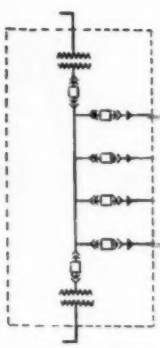


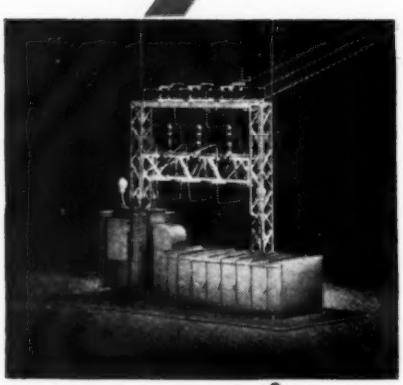


❄ The new G-E *package substation* provides one complete co-ordinated package for substation applications requiring steel structure and associated equipment, together with one or more *master unit substations.*









You have all this equipment from which to select a standard package substation:

Complete Steel Structure **including**

Lightning arresters — Buses and bus supports
Disconnecting switches — Station lighting
Potential transformers and current transformers

Outdoor oil circuit breakers — ***Metering and relaying***

Master unit substations — ***Control cable***

Complete drawings and erection instructions

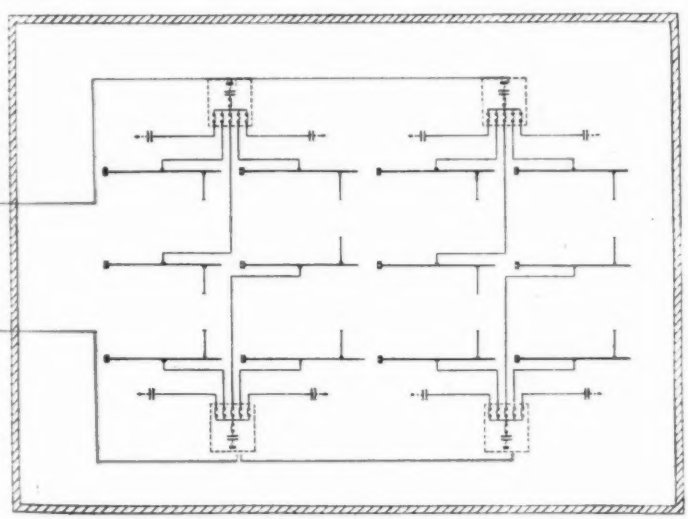
Substations *

They extend the "buy it complete" trend to applications requiring steelwork and master unit substations—with ratings from 750 to 45,000 kva; 11 to 69 kv, incoming, and 2.4 to 13.8 kv, outgoing

Here are the new G-E package substations! Clean-cut in design, complete to the last bolt of the steel structure—as compact and fully co-ordinated as modern engineering can make them.

These new package substations now extend to all outdoor substation applications the quick-ordering, time-saving, easy installation advantages so successfully introduced by General Electric's master and load-center unit substations.

The package substations you see here are just a few of the hundreds of standard combinations of the equipment



One line diagram showing how new package substation dovetails with load center system in industrial plants.

listed on the opposite page. You can order a package substation that exactly fills your functional requirements and forms an integral, *flexible* part of your plant's existing, or planned load center power distribution system. It arrives at your plant complete with steel structure and *all* necessary electric equipment—a fully co-ordinated, ready-to-install unit.

HERE ARE THE TIME-SAVING MONEY-SAVING ADVANTAGES OF G-E PACKAGE SUBSTATIONS

1. Out-of-the-catalog ordering.

There are hundreds of standard G-E package substation combinations. You'll likely find the basic combination that fits your needs in GEA-4500 (described below). It's then surprisingly easy, you'll find, to order a package substation with the functions, ratings, circuits and physical arrangement to exactly match your specific needs. *One specification* and *one order* complete the job—at a fraction of the cost in time and dollars usually required to plan and order the substation in the conventional way.

2. Quick, easy installation.

Your package substation arrives in factory-assembled sections as large as shipping and handling facilities permit. It includes everything you need—right down to complete erection instructions—so that you can put the entire substation on the job quickly, easily, and economically.

3. Flexibility for future needs.

Centralized design of G-E package substations permits exceptional flexibility to meet changing plant power requirements. Capacity can be added—or removed—at little cost and in easily handled "blocks of power" to take care of increased power requirements, load shifts, or relocations.

Look into these inherent economies of G.E.'s new package substations, in terms of your next specific application. We believe you'll be pleased with the over-all savings it offers you. General Electric sales representatives will gladly work with you on any substation application you may have in mind. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

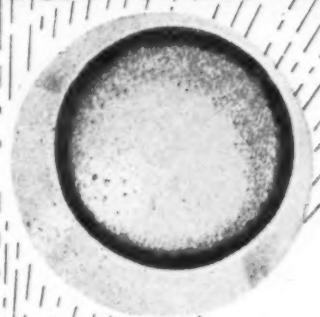
Ask for a copy of GEA-4500. This new 78-page bulletin illustrates 30 standard classes of package substations, gives you helpful application information on each and shows you just how each will look installed. Your G-E sales representative can provide a copy or write to Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

***FOR BETTER SCHEDULING OF DELIVERIES*—Consult us early. A package substation matched to your needs can be ordered promptly, saving you months of detailed planning—moving up your delivery schedule.**

GENERAL ELECTRIC

PICTURE OF A CASTING FAILURE

—that will never happen!



• There's a deeply hidden flaw here —an imperfection that might cause trouble later if it went undetected now.

A Sivyer radiographic picture caught it. Now it can never wear the Sivyer diamond —for this is the mark of sound castings.

In other ways, too, Sivyer steel castings must pass the test. They must possess close dimensional accuracy . . . be true to pattern contour and shape . . . have an extra degree of finishing for less processing on your part.

These are the reasons critical buyers specify Sivyer castings for more satisfactory, more lasting service.

SIVYER STEEL CASTING COMPANY
MILWAUKEE CHICAGO

"These New Units Put Power Where It's Needed..."

Says Contractor Installing Allis-Chalmers Dry-Type Transformers in Modern Food Plant!

THE BERCUT-RICHARDS PACKING COMPANY, largest individually owned packing plant in California, maintains strictest standards of cleanliness in all of its food handling processes.

An important factor in upholding these standards is the placement of *adequate lighting* over equipment. For this type of all-important load-center service their electrical contractor chose Allis-Chalmers new Class "B" Insulated Dry-Type Transformers which offered such advantages as: 1) ⅓ smaller size; 2) up to 38% lighter; 3) less mounting support needed than with conventional Class A insulated units; 4) valuable savings in secondary wiring and installation time.

Want more details on these *modern* units? See your nearby Allis-Chalmers dealer or sales office, or electrical contractor. Send for Bulletin B6382. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 2120

INDIVIDUAL LIGHTS, placed at work center over equipment, aid in cleaning and packing asparagus in Bercut-Richards' modern food plant.

ALLIS-CHALMERS

★ One of the Big 3 in Electric Power Equipment
Biggest of All in Range of Industrial Products ★

Dry-Type Transformers

BETZ

Boiler Water Conditioning
is a CONTINUOUS SERVICE

Efficient operation of any steam plant calls for properly controlled combustion, well-maintained auxiliaries and low maintenance. High on the list of important factors that affect efficiency is a complete — and *continuous* — program of boiler water conditioning. Such a service is provided by W. H. & L. D. Betz.

Betz continuing service consists of initial investigation, the establishment of plant control, a daily testing program for boiler room operators, periodic analyses of water samples in the Betz laboratories, frequent engineering reports by Betz engineers on plant operations, and a never-ending program of research.

Over 20 years of experience as water specialists has made the Betz boiler water conditioning service complete . . . economical . . . *continuous*. Our staff of engineers will welcome the opportunity of discussing your boiler water problems.

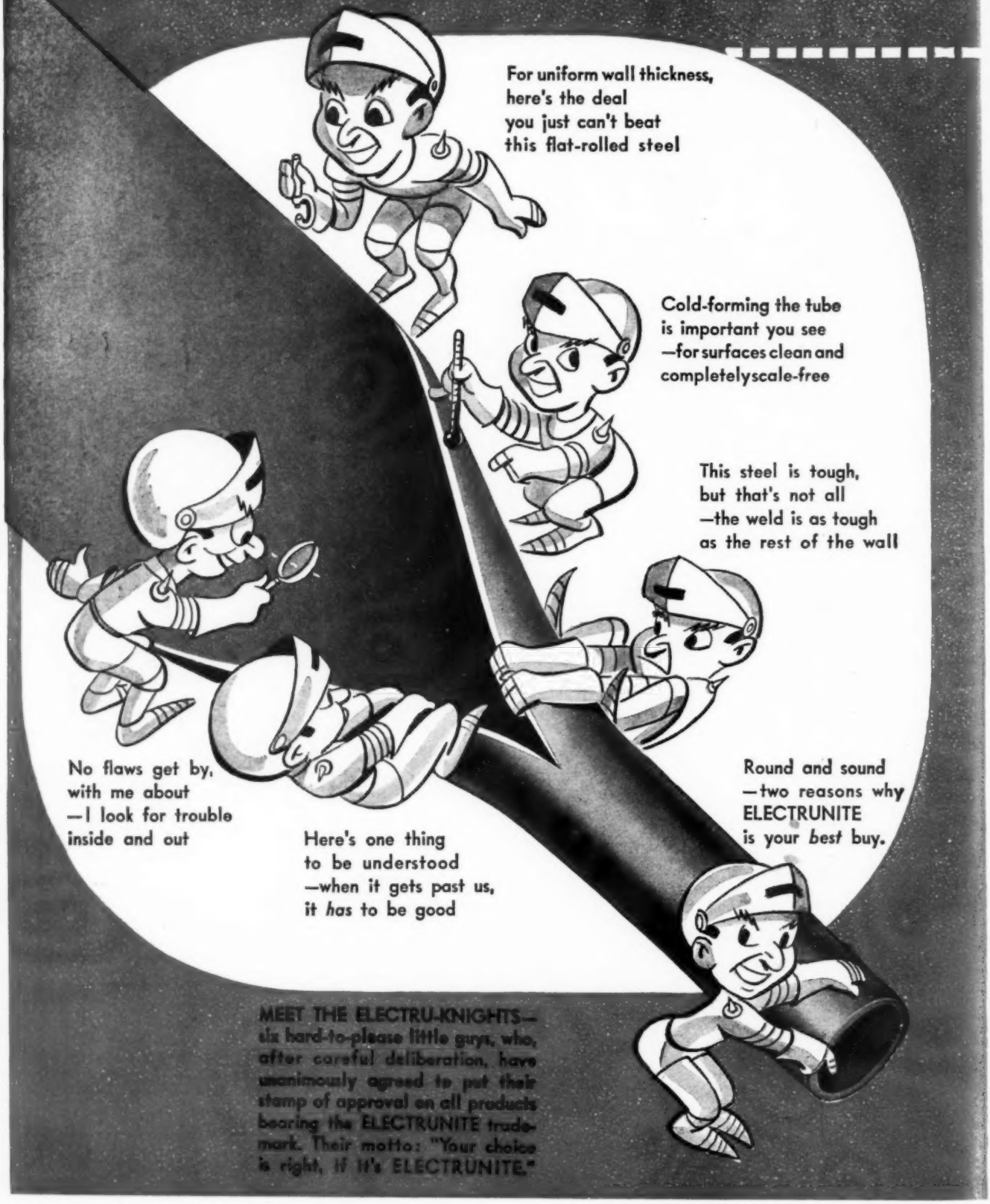
WRITE TODAY FOR FREE BULLETIN
giving a practical explanation of the phenomena of boiler metal embrittlement (intercrystalline cracking)—a concise discussion of causes, detection and prevention. Ask for Bulletin 104-A. W. H. & L. D. Betz, Gillingham and Worth Streets, Philadelphia 24, Pa.

BETZ

BOILER WATER CONDITIONING • COOLING WATER CONDITIONING INDUSTRIAL WASTE TREATMENT

Cover photograph from the *Betz Indicator*, a monthly publication devoted to the chemistry and practical applications of water conditioning. The *Betz Indicator* will be mailed without charge at your request.

ELECTRUNITE


For uniform wall thickness, here's the deal you just can't beat this flat-rolled steel
Cold-forming the tube is important you see —for surfaces clean and completely scale-free
This steel is tough, but that's not all —the weld is as tough as the rest of the wall
No flaws get by, with me about —I look for trouble inside and out
Here's one thing to be understood —when it gets past us, it *has* to be good
Round and sound —two reasons why ELECTRUNITE is your *best* buy.

MEET THE ELECTRU-KNIGHTS—six hard-to-please little guys, who, after careful deliberation, have unanimously agreed to put their stamp of approval on all products bearing the ELECTRUNITE trademark. Their motto: "Your choice is right, if it's ELECTRUNITE."

A WORD THAT MEANS *Electrically United*

Also means the Best In Quality Pressure Tubes

● Derived from two words, ELECTRically UNITEd, the name ELECTRUNITE applies both to Republic's complete line of boiler, heat exchanger and condenser tubes, and the process by which they are manufactured.

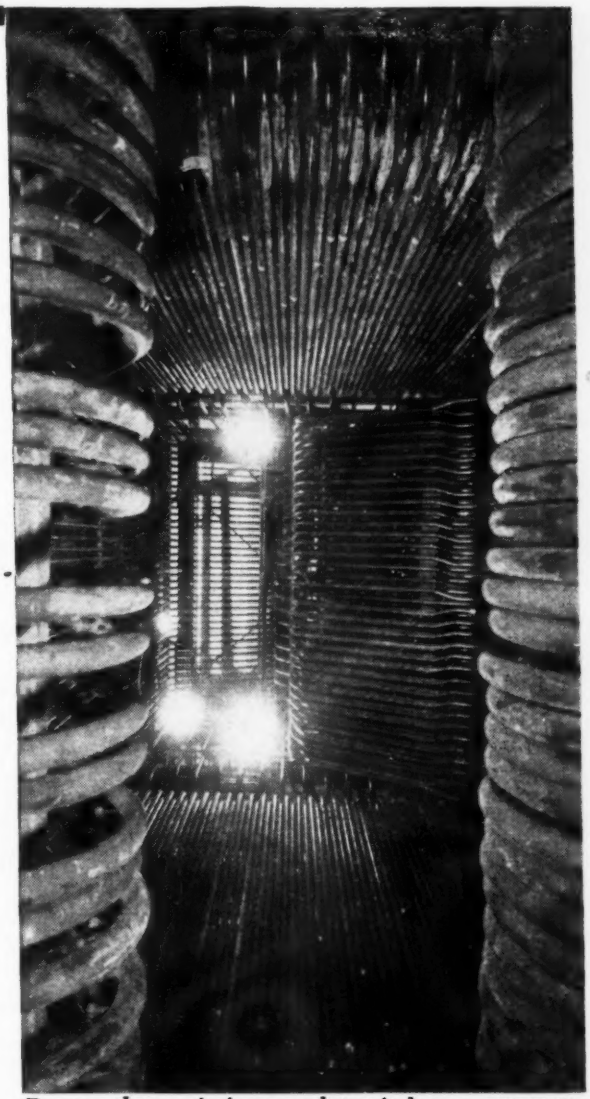
The ELECTRUNITE Process is the *original* process in which flat-rolled steel is accurately cold-formed into tubular shape and electrically welded into sound, dependable tubing.

From this proved method of tube manufacture come many of the money-saving qualities which you get in every ELECTRUNITE Pressure Tube—*strength, toughness, uniformly high ductility, freedom from scale, ease of installation and trouble-free long life.*

In the past fourteen years, more than 150,000,000 feet of ELECTRUNITE Pressure Tubes have been installed in many types of steam generating and heat transfer equipment used throughout all industry. Actual service records of countless installations offer positive proof of the economy and reliability of ELECTRUNITE Tubes in everyday use.

ELECTRUNITE Pressure Tubes are produced in both carbon and stainless steels, in a wide range of sizes, gauges and analyses. Complete information on request...write to:

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York



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INCO PRECISION CASTINGS SAVE TIME AND MONEY

FUEL PUMP ROTOR

Formerly required 3 or 4 operations on 3 to 5 different machines. Note grooves on internal surface.

CLUTCH GEAR

Saved complicated machining. Also avoided at least one sub-assembly, i.e., force-fitting, welding or brazing the projecting key on small end.

FLIGHT CONTROL INSTRUMENT COVER

(*Cutaway section*) Originally machined from bar stock, taking a 9-day production schedule. Note intricate recesses and studs in recesses.

Above parts are made of "S" Monel

NO. 4

Helpful Hints on Applying Capacitors

The Use of Series Capacitors for Industrial Circuits

Capacitors installed for power-factor improvement are normally connected in shunt with the load or system, providing an out-of-phase component of *current* to supply reactive kva. (See Fig. 1A.) In certain applications, however, capacitors perform another valuable function when connected *in series*. (See Fig. 1B.) Used this way, they provide an out-of-phase voltage component which has the effect of evening out voltage level under rapid intermittent loads. This is commonly known as "stiffening" the system.

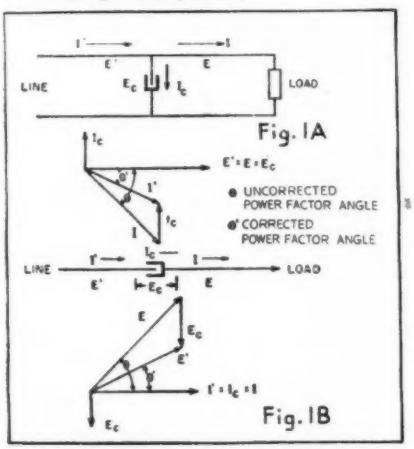

Fig. 1A

Fig. 1B

DUAL-PURPOSE APPLICATIONS

In applications of series capacitors to "stiffen the system" for motor starting and the like, the capacitor kva is not high enough to raise the power factor significantly. In other cases, as on resistance-welding applications, for example, one of the functions of the series capacitor is to effectively furnish power-factor correction by compensating for the welder reactance. A shunt-connected capacitor is undesirable in this application because its output is constant and does not follow the load. The series capacitor, however, allows the feeder to handle more or larger resistance welding load.

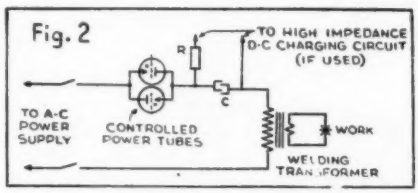

Fig. 2

METHODS OF APPLYING SERIES CAPACITORS

When series capacitors are to be applied to resistance-welding circuits, their capacity and the circuit connections must be matched to the system of control (see Fig. 2). The following information is necessary to calculate capacity.

1. Kilovolt-amperes (volts × amperes ÷ 1000) and power factor (watts ÷ volts × amperes) under maximum working conditions.
2. Kilovolt-amperes and power factor with the electrodes directly short circuited, in order to determine maximum current and the protective requirements.
3. Line voltage and frequency.
4. Type of control, that is, mechanical contactor, synchronous or non-synchronous electronic control.
5. Duty cycle (cycles on, cycles off, pulsation per weld, and welds per minute).

The calculations required are made easy by the use of curve sheets* available for various supply voltages.

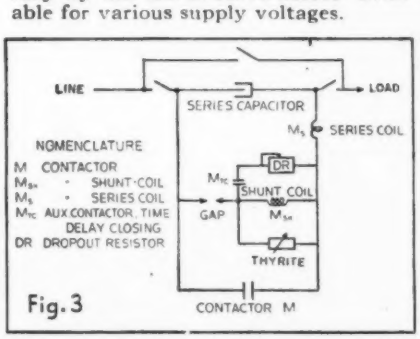

Fig. 3

PROTECTIVE CIRCUITS FOR SERIES CAPACITORS

As the voltage across the series capacitor is a function of circuit current, it may be dangerously high for the dielectric under short-circuit fault conditions. A protective circuit may be desirable to by-pass such overloads, automatically reinserting the capacitor in the circuit when the fault current decreases to a predetermined value. See Fig. 3.

Whatever your problem in correcting power factor, eliminating light flicker or other function for which capacitors offer a remedy, G-E application engineers will be glad to work with you in selecting and applying them. Just call your local G-E representative. ***Apparatus Department, General Electric Company, Schenectady 5, N. Y.***

* Application of Series Capacitors to Resistance-welding Machines, reprinted from *Welding Journal*, Jan. 1943, GET-1134.

GENERAL ELECTRIC

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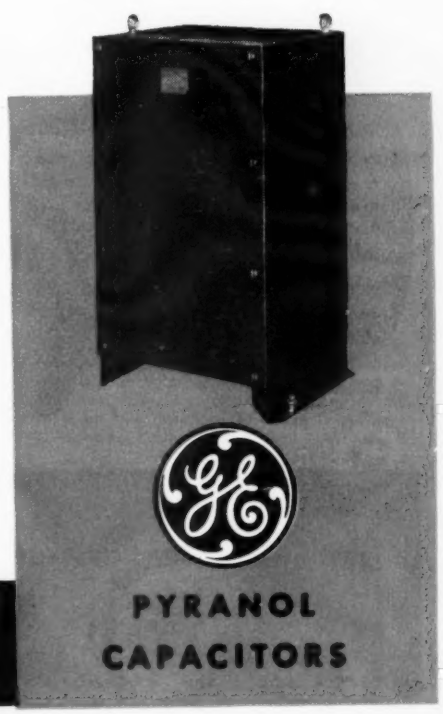

PYRANOL CAPACITORS

Production, Prosperity and POWELL

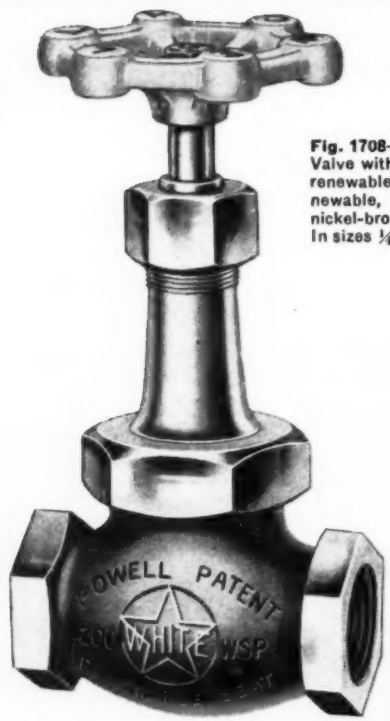

Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable seat rings and regrindable, renewable, wear-resisting "Powellium" nickel-bronze semi-cone plug type disc. In sizes ¼" to 3", inclusive.

Fig. 1793—Large Iron Body Bronze Mounted Gate Valve for 125 pounds W. S. P. Made in sizes 2" to 30", inclusive. Has flanged ends, bolted flanged yoke, outside screw rising stem and taper wedge solid disc. Taper wedge double discs can be provided in sizes 2" to 12", inclusive. Seat rings and stem are in bronze. Disc is bronze in 3½" and smaller size valves and bronze faced in the larger sizes. Also made in All Iron.

Fig. 241—125-pound Iron Body Bronze Mounted Globe Valve. Made in sizes 2" to 16", inclusive. Has flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc. Also available in All Iron.

POWELL

VALVES

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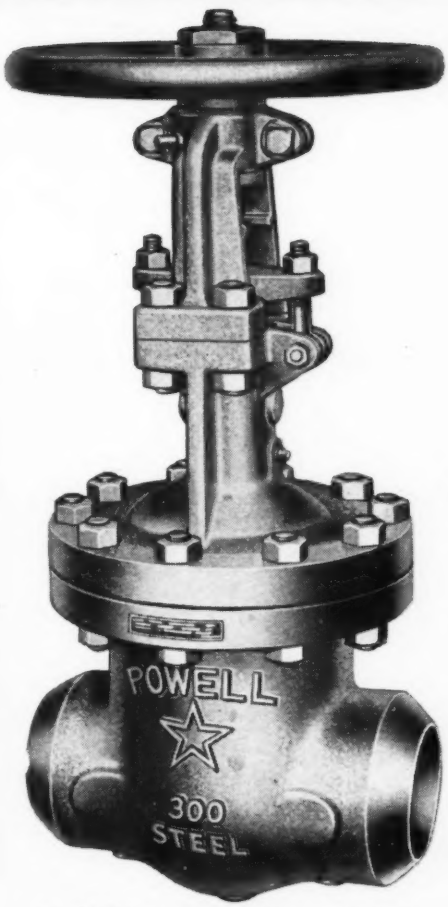

Fig. 3003 W. E.—Class 300-pound Cast Steel Gate Valve. Has welding ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc. Powell Cast Steel Valves of all types are available in pressure classes from 150 to 2500 pounds, inclusive.

Fig. 375—200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze taper wedge solid disc in sizes ¼" to ¾", inclusive; taper wedge double disc in sizes 1" to 3", inclusive.

The Wm. Powell Company
Cincinnati 22, Ohio

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Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve. Made in sizes 2" to 16", inclusive. Has flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc. Disc, when wide open, permits full, unobstructed flow through the valve body. Also available in All Iron.

VALVES

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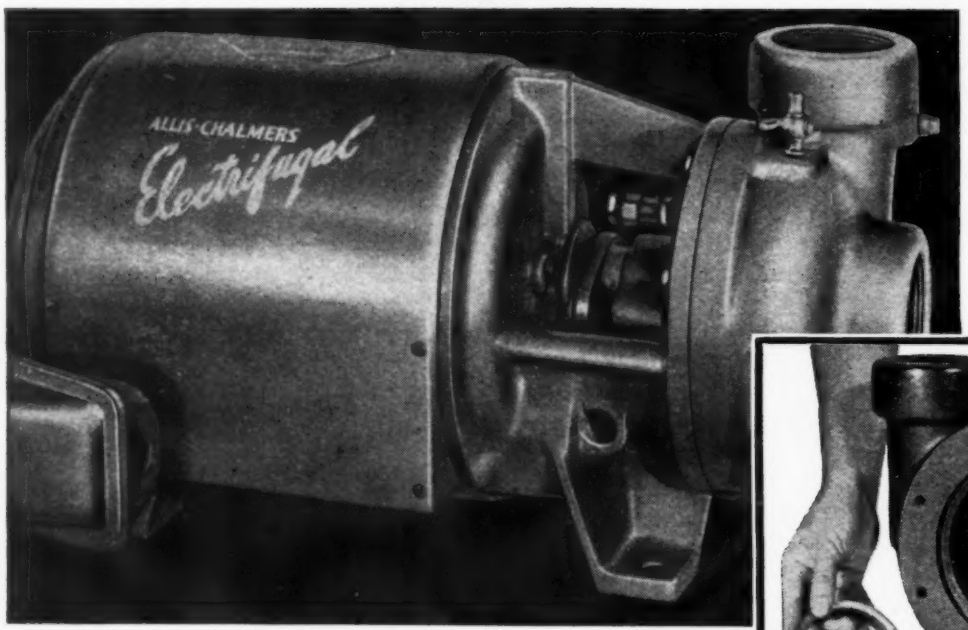

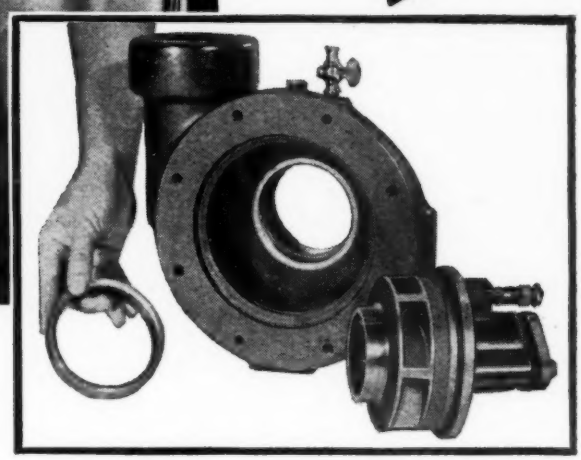

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AS THIS photo suggests an "Electrifugal" pump is simple and sturdy in design. Moving parts are few and easy to get at. The pump can be taken apart readily, for inspection and replacement of packings or wearing rings, when necessary.

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In addition to "Electrifugal" pumps in capacities for 15 gpm to 1600 gpm, heads to 500 feet, motor hp ratings from ¾ to 25 hp — Allis-Chalmers designs and builds a complete range of sizes and types of centrifugal pumps up to capacities of 170,00 gpm.

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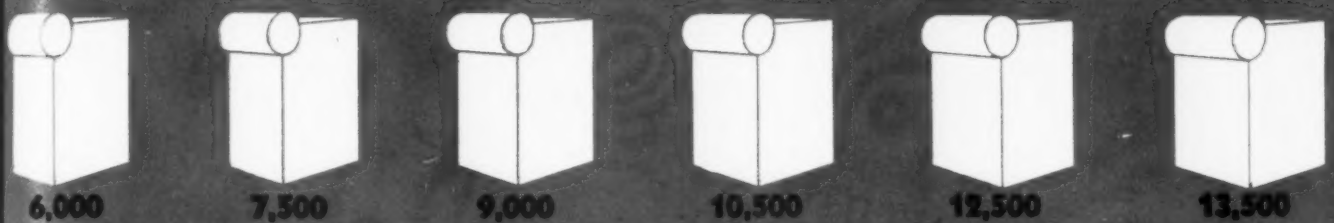
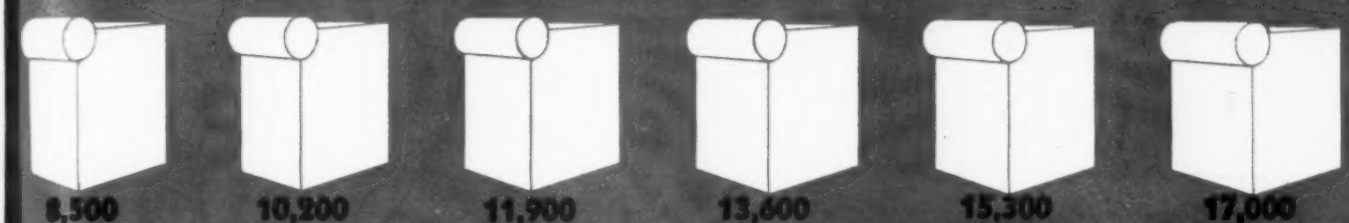
Electrifugal PUMPS

Standardized!

. . . to save you time and money

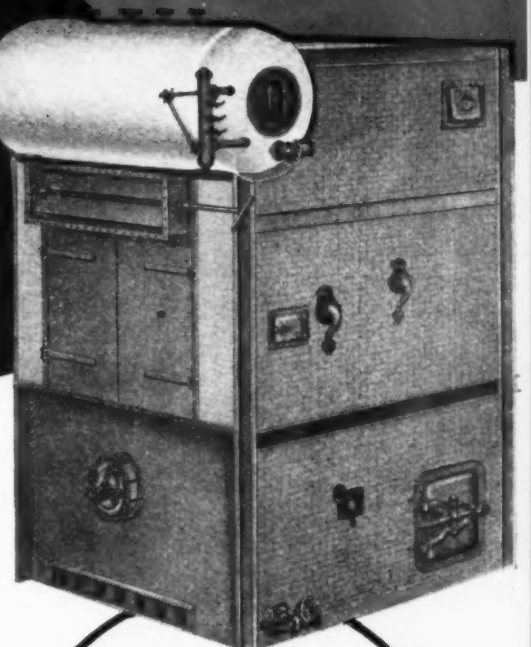


pounds of steam per hour (10 ft. tubes)



pounds of steam per hour (12 ft. tubes)

type "m"



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Ample clearances, high quality workmanship and proved features of design assure reliable operation over long periods of use.

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particularly where steam also is required for heating or process.

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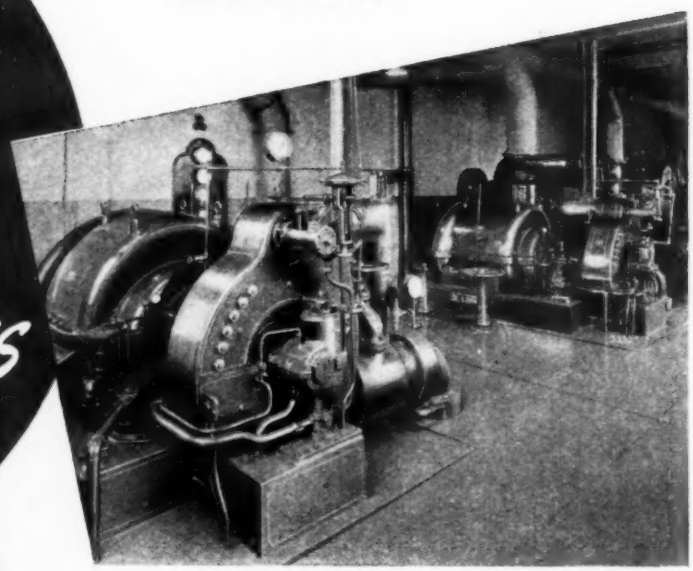

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a first step

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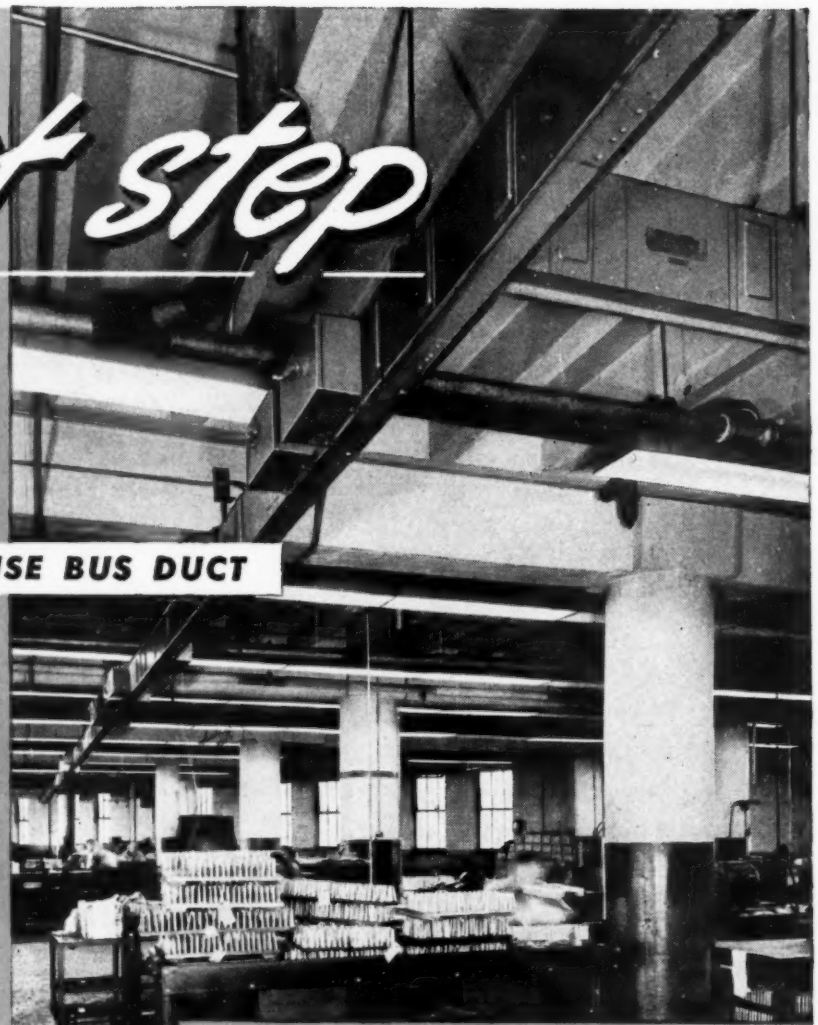

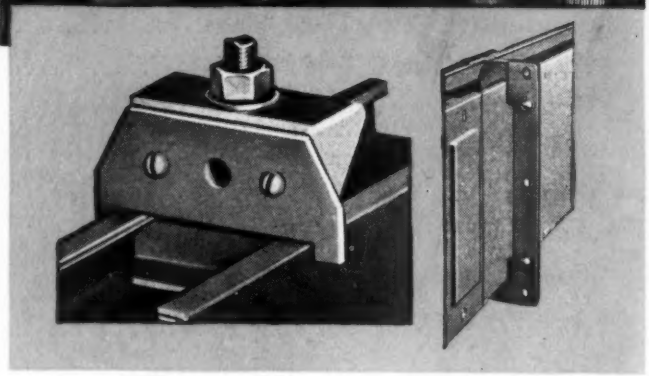

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POWER FACTOR BONUS—credit for power factor maintained at or above a predetermined value.

...or this?

KVA DEMAND RATE—power rate determined by the KVA demand.

...or this?

PENALTY FOR LOW POWER FACTOR—billing rate increased for power factor below a predetermined value.

If your plant load is made up of inductive apparatus such as motors, welders and induction heating equipment . . . Westinghouse capacitors can probably reduce your power costs.

Apparatus such as this draws more current than is represented by the kilowatthour meter readings. Most utilities offer an inducement for removing this current from their circuits.

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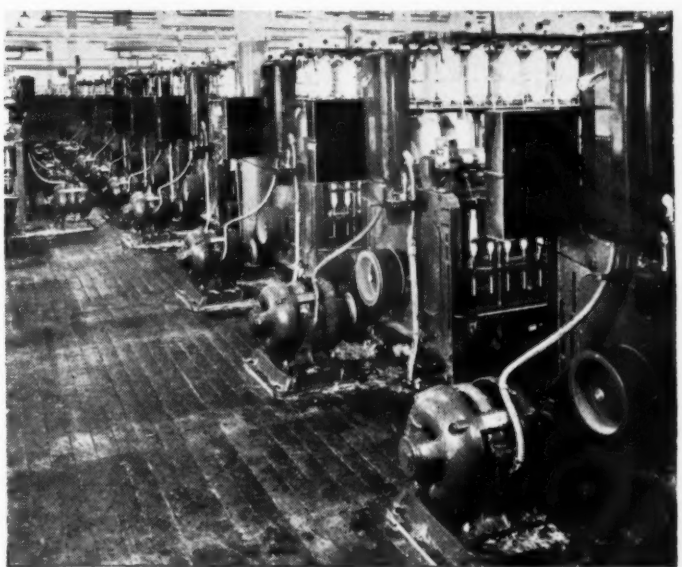

In this large textile mill, power-factor improvement is provided by an individual dust-tight Westinghouse capacitor with each spinning frame motor. Motor control also connects and disconnects capacitors.

Westinghouse Inerteen Capacitors are fireproof and have hermetically-sealed, welded steel cases. The exclusive "Solder-Seal" bushing eliminates the need for gum or gaskets and assures a permanent seal. There's nothing to wear out.

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Capacitors

Here's why BYERS WROUGHT IRON resists corrosion

Want to know the secret *why* Byers Wrought Iron resists corrosion . . . *why* designers use it in the "hot spots" where ordinary materials fail too soon . . . *why* it has helped to stave off repairs and maintenance in hundreds of punishing applications?

You'll find the main answer in the photomicrograph, that shows how a minute piece of wrought iron, not much larger than a grain of sand, looks when it is magnified 100 times. Tiny fibers of "iron glass" (silicate slag) are threaded through the body of high-purity iron. As many as 250,000 of these threads are present in each square inch of section, making up from 1 to 3% by weight of the material.

When corrosion strikes, the fibers serve as a mechanical barrier, to halt and diffuse attack. This discourages the pitting and rapid penetration that are generally the cause of premature failures in ordinary materials. The fibers also help to anchor the initial protective scale, which shields the underlying metal just as a scab protects a wound.

Authorities are agreed that the primary reasons for the unusual corrosion resistance of wrought iron is the combination of high-purity base metal, and glass-like silicate slag. No other metal duplicates the nature and composition of wrought iron . . . *and so no other metal duplicates the resulting service qualities.*

Every engineer recognizes that the uncertainty of future costs and conditions makes it more important than ever to design for maximum durability. Our Engineering Service Department will be glad to help you apply wrought iron in the places where it can serve longer for less. You will find full dimensional information in our General Catalog, sent on request.

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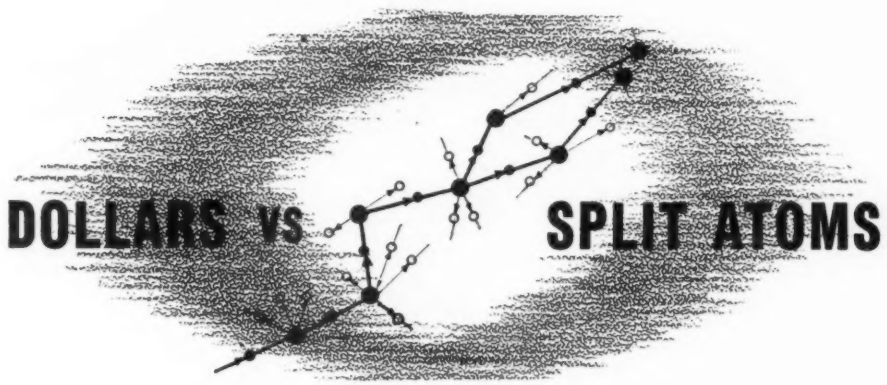
POWER

PHILIP W SWAIN, EDITOR • NOVEMBER 1946 • ESTABLISHED IN 1882



NEARLY A CENTURY after the "forty niners," a public-spirited team of California engineers and scientists is blazing a trail into the unknown land of atomic-power economics. Their report (page 78) will instruct and amaze power engineers everywhere.

One must study the whole report to grasp its revolutionary character, but here are sample conclusions simplified for quick reading:

1. Big "primary plants," heavily guarded, will "burn" natural uranium in slow-neutron piles to produce power plus byproduct plutonium.

2. Smaller secondary plants will "burn" this plutonium (first denatured to prevent atom-bomb bootlegging) to make more power.

3. A typical setup would be one 500,000-kw primary plant supplying plutonium fuel to five 100,000-kw secondary plants.

4. Burning 10,000 lb of natural uranium yearly, at a total fuel cost of $100,000, the primary plant can turn out 2.2 billion kwhr—also 500 lb of plutonium. Fuel cost of each primary-plant kwhr is then less than 1/20 mill—practically zero.

5. Selling 100 lb of plutonium per year to each secondary plant at $10,000 per lb will yield the primary plant $5,000,000 plutonium income.

6. In the five secondary plants this plutonium will produce another 2.2 billion kwhr at a fuel cost under 2.5 mills per kwhr.

7. Fixed charges will be moderate for a 500,000-kw primary plant, but not for a 100,000-kw primary plant. Yet few power systems could conveniently absorb a 500,000-kw increment. That's one big hurdle for atomic power.

8. Another is the terrific complication of radioactive-waste disposal.

9. Self-supporting American atomic-power plants within ten years are possible.

10. Aside from political action nothing that can happen to the cost of mining, refining or transporting uranium can affect the costs of atomic power for many decades to come.

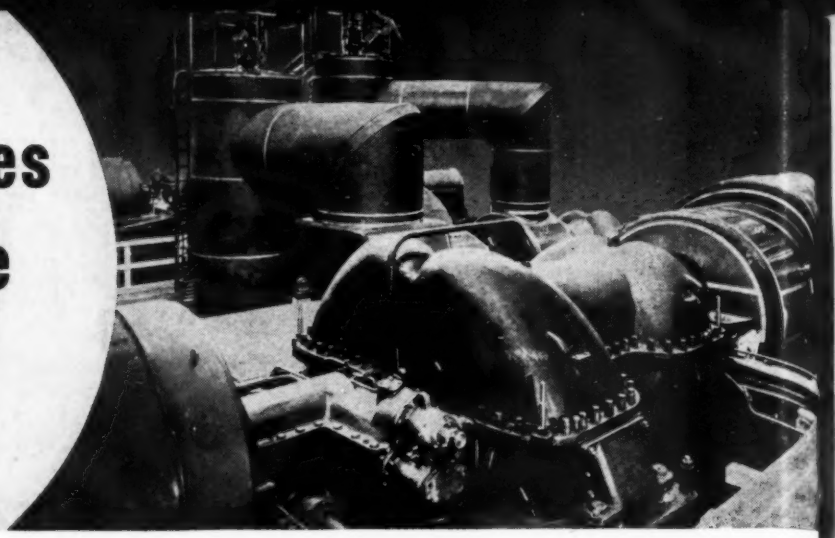
11. Yet atom splitting can make no sensational reduction in American central-station power costs; the only possible saving is a fraction of the present 2-or-3-mill fuel cost.

12. However atomic power may help revolutionize industry and life in far countries where coal and oil are exorbitantly expensive. Unless uranium supply is deliberately suppressed, the unit fuel cost of primary reactors throughout the world will be equalized at practically zero.

Such challenging conclusions are not to be accepted blindly on anybody's say-so. This thoughtful study by the California group must face intensive analysis and debate. That will be good for all concerned.

The story of atomic-power costs is too new, strange and important for adequate treatment in a single article. We editors propose to keep it constantly before POWER readers in the months to come, and to air all competent viewpoints impartially.

Where Gas Turbines Will Fit In Future Power Fields: I



Hans Pfenninger, gas-turbine engineer for Brown Boveri, has prepared an exclusive story in collaboration with S A Tucker, McGraw-Hill World News. They review and summarize present development and application of units built in Switzerland, with a view toward their economic position in future plants

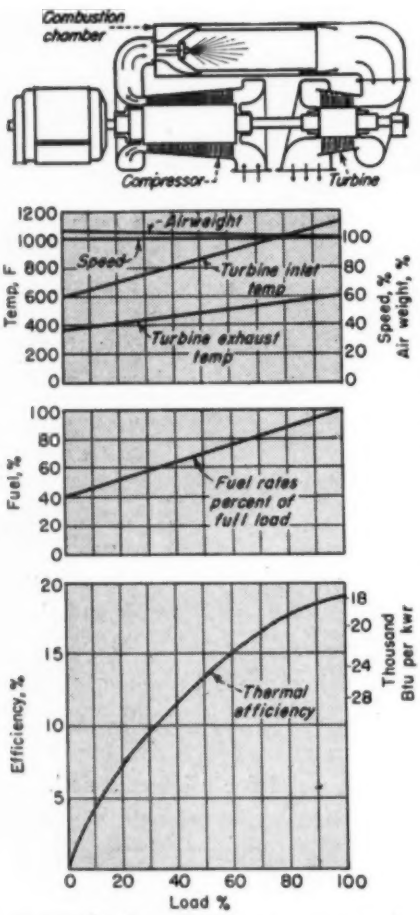


Fig. 1—Typical performance of single-shaft peak-load or of standby set without a regenerator for constant speed. Load regulation by temperature only

▶ DURING RECENT YEARS the gas turbine has been developed to an extent that it can now be considered commercially competitive with other prime movers for certain applications. In the present period, of new construction, the gas turbine will be economically suited to several specific applications. Consider first the gas-turbine plant for standby and peak-load service in sizes up to 10,000 kw, as now being built on firm orders in Switzerland.

Since commercial units are so far being built only for liquid and gas fuels, immediate application is limited to fields where such fuels are available at low cost. It is rather surprising to some that prewar worldwide fuel costs show bunker C available in many parts of the globe at less cost per Btu than coal or any other fuel, Table I. Trend of immediate postwar fuel prices in Europe still indicates bunker C as a relatively low-cost fuel in comparison with others. Hence construction of gas-turbine power units for oil burning is actively under way at present.

Where coal is less costly than fuel oil, new methods of gas production seem likely to lead to applications of gas turbines supplied by gas producers now under development. However, such plants still appear relatively expensive. While several separate experiments are under way aimed at direct firing of coal in gas-turbine plants, definite results will not be known for some time yet.

Standby and Peak Load. For stationary power use, gas turbines have first appeared as standby or peak-load plants where the cost of fuel has been of lesser importance than other considerations. Where the number of service hours is small, the deciding factor has been initial cost, and for this service the gas turbine offers the least plant cost. In its simplest form, Fig. 1, the gas turbine meets requirements of quick starting, small space, low weight, simple attendance and low-maintenance costs. No cooling water is required for sizes up to about 6000 kw.

Having no reciprocating parts, the gas turbine needs no heavy foundations. The only auxiliary apparatus is a starting motor and electrical supply. Regulation is simple, with a constant-speed governor controlling the fuel flow to the combustion chamber. Since the air quantity remains approximately the same at constant speed regardless of load, the effect of regulating fuel flow is a reduc-

Table I—Prewar World Market Prices of Four Fuels

	Gas oil	Diesel oil	Bunker C	Coal
Heat value, Btu per lb	18,000	18,000	18,000	12,600
Price, cents per lb	0.60	0.52	0.30	0.25
Price, cents per gal	4	3.7	2.2	....
Price, cents per 18,000 Btu	0.60	0.52	0.30	0.36
Price, % of bunker C	200	173	100	120

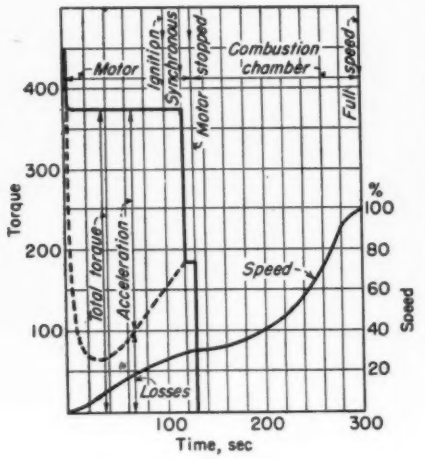


Fig. 2—Starting performance for the single-stage plant of Fig. 1. The normal time from dead cold start to full load can be as little as five minutes

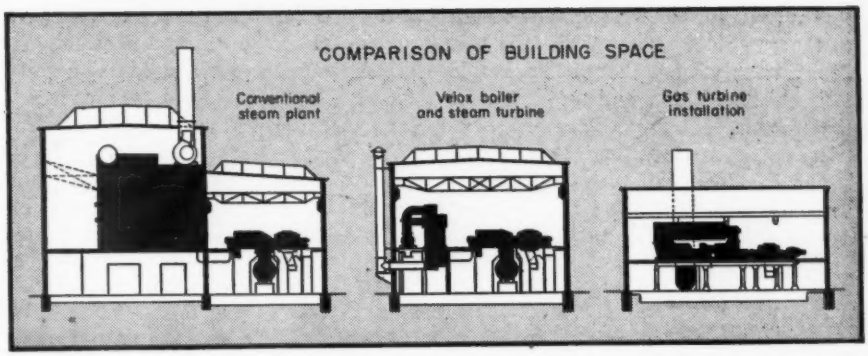


Fig. 3—Comparison of building space requirements and construction for equal output of conventional steam-turbine plant, steam turbine with a Velox boiler of typical European design, and single-stage standby or peak-load gas turbine

tion in temperature at the turbine inlet at partial loads.

Fig. 1 shows the essential data for a single-shaft single-stage standby or peak-load plant at partial loads. Since the speed, and therefore weight of air flowing, remains practically constant at all loads, almost instantaneous power variations from zero to full load, and vice versa, are obtained.

From Fig. 2, it can be seen that starting time from rest to full load is about five minutes. The starting motor brings the shaft up to 25 to 30% normal speed, using a considerable part of the starting torque for acceleration. At about 25% speed, oil is ignited in the combustion chamber by an electrical ignition rod. Full speed is reached in about three minutes, and held constant by a speed governor. The unit can be immediately loaded.

Maximum speed variation from zero to full load is 4 to 5%. Space requirements, including all auxiliaries, are about 10 cu ft per kw. A comparison with steam practice is illustrated in Fig. 3. The complete gas-turbine plant, including electrical equipment but excluding foundations, weighs 45 to 60 lb per kw. Size, without intercooling, ranges from a practical minimum of 900 kw to about 6000 kw as maximum output.

Larger Units. For the size range between 6000 and 10,000 kw, intercooling between two compression stages is advantageous. Power to the compressor is somewhat reduced and output of the set for the same weight of air is increased, making for reduced fuel consumption.

With an intercooler, Fig. 4, the gas-turbine plant requires only about half the volume of air for the same power output as the single-stage unit. The limit of output at 3000 rpm, corresponding to 50-cycle electric generation, is now about 10,000 kw. Thermal efficiency without regenerator is about 21% at full load.

Two Combustion Stages. If an intermediate combustion stage can be utilized, Fig. 5, the useful power output of a given machine can be increased and the thermal efficiency improved to about 23% at full load. With this arrangement, since the expansion as well as compression takes place in two separate stages, it is better to divide the set into two independent units. This has the advantage of coupling machines of the same specific speed together, which results in slightly improved efficiency and lower cost.

In this arrangement the high-pressure turbine drives only the high-pressure compressor. The useful output of the high-pressure set appears as added pressure drop available in the low-pressure

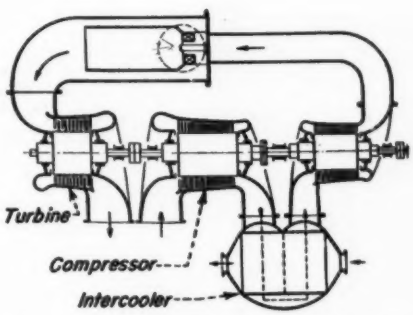


Fig. 4—The addition of a single stage of intercooling allows building as much as 10,000 kw in a single-shaft unit for standby or peak-load service

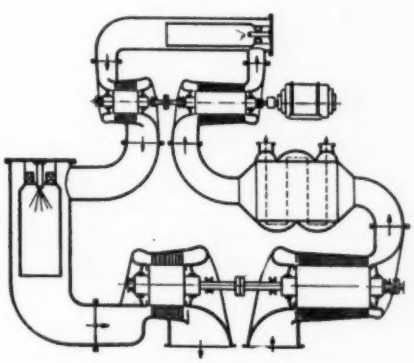


Fig. 5—Two-stage gas-turbine without regenerator and with generator coupled to low-pressure set for standby service as in unit built for Filaret

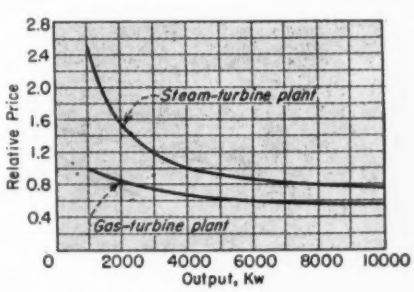


Fig. 6—Relative costs of complete standby gas-turbine plant and comparable steam plant for sizes to 10,000 kw under conditions at present time

Table II—Water-Consumption Comparison of Steam Plant for Condensing and Gas-Turbine Plant for Intercooling

	Water use, cu ft per kwhr	
	Gas turbine	Steam turbine
Output: 1000 to 6000 kw	0	11
Output: 6000 to 10,000 kw	2	9

turbine and, ultimately, as power output to the generator shaft. While the cost is appreciably below that of comparable steam-turbine plant, and the weight of the unit, including auxiliary and electrical apparatus, is attractive at 40 to 50 lb per kw, the steam-turbine plant has better thermal efficiency, which restricts application principally to standby and peak-load plants.

Where an intercooler is used water is the best cooling medium. Only a relatively small quantity is required compared to steam plants, Table II, an important factor in initial cost. Where water is not available, it is possible to utilize rather large and bulky air coolers but it would seem more practical to use multiple-unit arrangements of the type shown in Fig. 1 that need no water.

Base-Load Power Units. With regenerators of sufficient size, thermal efficiencies of 30% (11,400 Btu per kwhr) can be obtained with gas-inlet temperature to the turbine of 1100 F. With gas-turbine plants, however, a considerable difference in layout and initial cost is found between plants for (1) constant load and (2) variable load.

Where efficiency at partial loads is not a deciding factor, units from 1000 kw to 6000 kw can be built single shaft, with a regenerator as in Fig. 7 for thermal efficiencies of about 25%. While initial cost is low, partial-load efficiency falls rapidly as indicated.

One or several intercoolers, Fig. 8, result in lower initial cost, Fig. 9. If efficiency is of deciding importance, for plants above 6000 kw, intercooling is essential. Fig. 9 is based on cost of water supply at 10% of total plant cost. To a certain extent, smaller or larger intercoolers and, conversely, larger or smaller regenerators can be interchanged without appreciably changing plant cost or efficiency.

As already pointed out, there are a great many possible gas-turbine arrangements. To arrive at the most suitable solution, one must know annual load conditions, cost of available fuels, and cost of cooling water.

For large outputs and high thermal efficiency, it is advisable to use intermediate combustion chambers in addition to intercooling. It is usually profitable to provide a separate gas turbine for each combustion stage. If sudden and great load variations are expected, the generator is best coupled to the low-pressure turbine, but if partial load operation is anticipated for long periods, higher part-load efficiency is obtained by attaching the generator to the high-pressure shaft as indicated in Fig. 12.

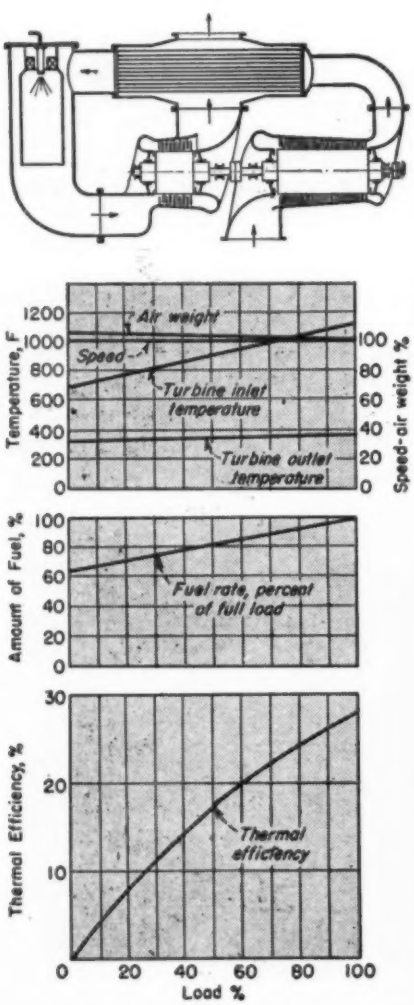


Fig. 7—Typical performance of single-shaft gas-turbine plant with heat exchanger designed for constant speed at all loads, temperature regulation

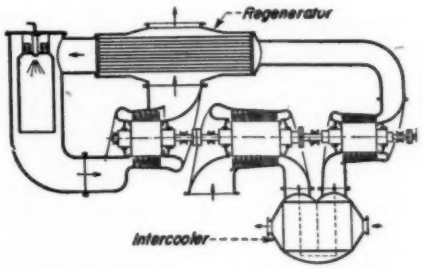


Fig. 8—If efficiency is a prime consideration, gas-turbine plants over 6000 kw have intercooling between compressors as well as regenerator

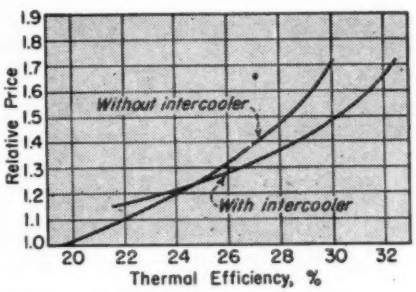


Fig. 9—Relative cost of 4000-kw gas-turbine plant with and without intercooler, both with heat exchanger, in terms of the desired efficiency range

Plants for Variable Loads. If high partial-load efficiencies are to be obtained, the gas temperature at turbine inlet has to be kept as high as possible at all loads. This can only be attained by decreasing the quantity of air flow, which, with axial flow compressors, requires varying compressor speed.

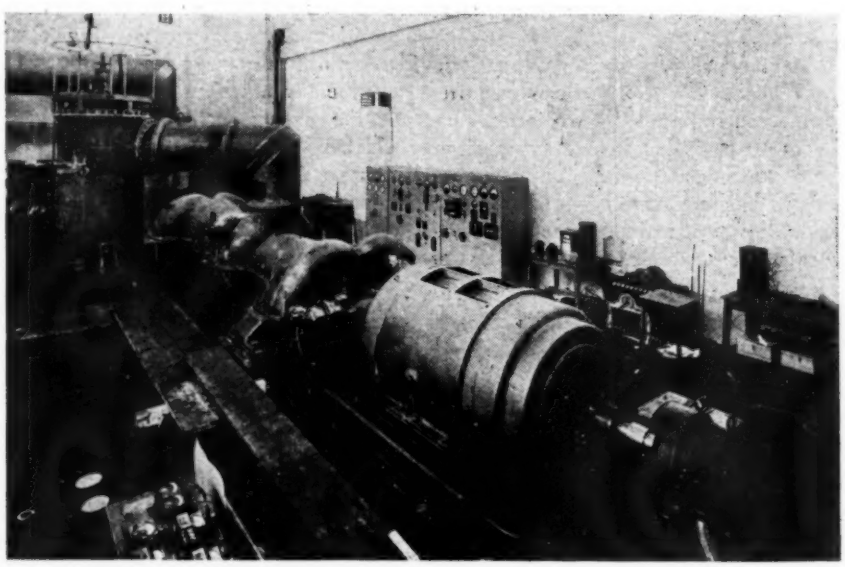


Fig. 10—Shop view of the 4000-kw gas-turbine set for Chimbote, Peru, for standby, with 19% test efficiency at 3600 rpm, and direct-connected generator

This change in compressor speed can, in turn, only be obtained by using two turbines, one driving a compressor at variable speed, the other coupled to a constant-speed generator. Fig. 11 illustrates the simplest such plant with a single combustion chamber, which could be built at a cost slightly higher than the arrangement of Fig. 7. The speed-governing device differs from constant-speed machines in that, for each load, not only must the amount of fuel be regulated, but a definite speed must be set for the compressor.

Fig. 11 shows the more important data for such a plant. Only a moderate fall-off in efficiency is found down to half load. A set of this kind can also be designed to have maximum efficiency at part load as is provided for gas-turbine locomotives.

For the largest outputs and best efficiency yet designed by Brown Boveri, the arrangement of Fig. 12 is practicable. The generator is driven by the high-pressure turbine for best part-load efficiency and the air flow is controlled by varying speed of the low-pressure compressor. Fig. 12 also shows the significant data for such a plant. No-load fuel consumption is about 15% of full-load. To increase load from zero to full requires accelerating the low-pressure set from 40% to 100% speed, requiring about 20 seconds. Weight of plant including generator and reduction gear is about 70 lb per kw and cooling-water consumption totals about one quarter gpm per kw, about one fifth that of a steam plant.

Status of Manufacture. At present eleven gas turbines are in manufacture at Brown Boveri. The smallest is designed for 1200 kw, and the largest for 27,000 kw. A 4000-kw set, Fig. 10, for a power station of the Corporacion Peruana del Santa at Chimbote, Peru, has already undergone shop tests showing approximately 19% thermal efficiency. Since it will be used in emergency service, it has no regenerator. The unit represents a considerable advance over the original Neuchatel standby power set (POWER, Feb 1940, pages 62-64). The limit of output of a single-stage gas turbine at 3000 rpm at that time (1939) was 4000 kw, while at the same speed one can now build up to 6000 kw or, as in the Chimbote machine, 4000 kw at 3600 rpm for 60-cycle operation with direct-coupled generator rather than gearing.

One of these units will be part of a blast-producing plant for a steel mill of Altos Hornos de Vascaya, Baracaldo, Spain. Gas turbine and steel blast heater are designed for blast volume of 53,000 cfm at 29 psia. Temperature attained by the blast air is 1400 F but inlet temperature to the gas turbine is held to 1100 F. The steel blast heater is fired with furnace gas compressed to supercharging pressure by a geared compressor driven from the end of the gas-turbine shaft. The combination will result in a heat consumption for producing and heating the blast estimated at about 20% less than for gas-engine or steam-turbine plant.

Also on the test bed at present is a 4000-hp gas-turbine set intended for a locomotive. Its weight including gear, generators and machine frame is 18 lb per hp, and the whole locomotive, as designed but not constructed, weighs 87 lb per hp.

Eight of the sets under construction employ regenerators. Two, recently ordered for winter service in Switzerland, one of 13,000 kw and one of 27,000 kw, are designed for a mean air-inlet temperature of 41 F. The larger set is being designed to burn heavy fuel oil, and will have a thermal efficiency of about 34%. Both units are intended for use only during the winter season of low hydroelectric-power stream flow and during a season of extreme cold air temperatures. Under such conditions thermal efficiencies are obtained that cannot normally be expected of other prime movers that can burn low-cost fuel oil.

Note: Part II of Mr. Pfenninger's article with further details concerning gas-turbine sets now being manufactured will appear in an early issue of POWER.

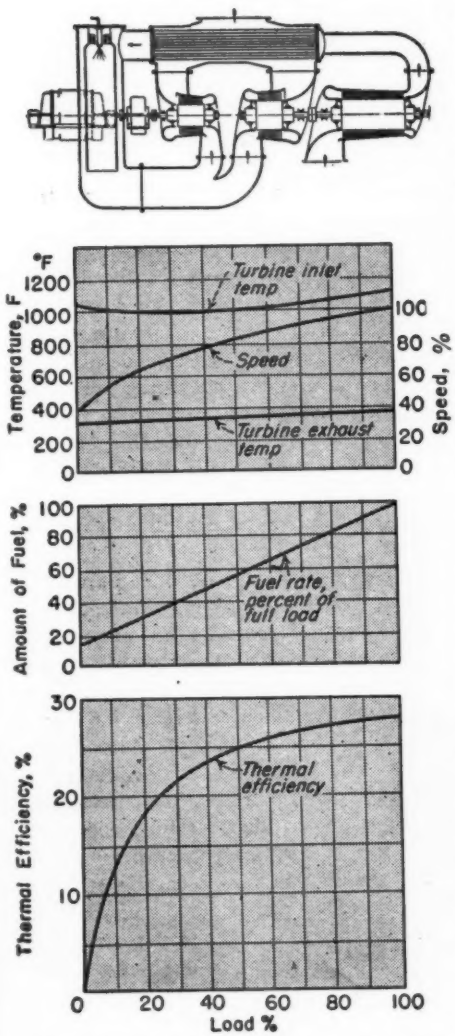


Fig. 11—Typical performance of 2-shaft unit with one turbine driving the constant-speed generator, and another the compressor at variable speed

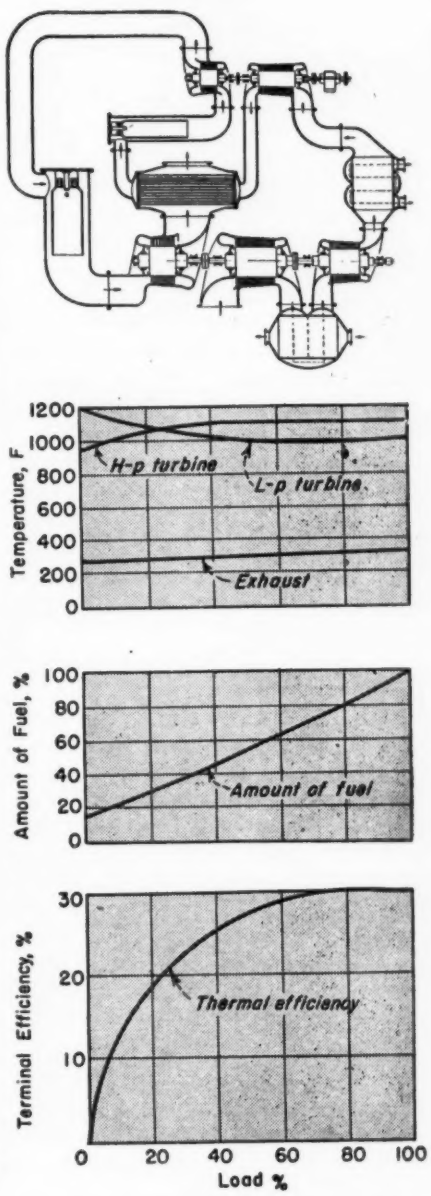


Fig. 12—Typical performance of large unit for best efficiency in which generator is driven by high-pressure turbine, compressor by low-pressure unit

Good Design, Proper Fabrication Make High-Temperature Piping System Safe: II

In his second article Sabin Crocker shows that know-how in flexibility calculations, metallurgical research, fabricating skill tends to reduce costs, better the job*

► MAIN STEAM PIPING for old and new sections of Delray Station affords an example of what can be done when careful design by competent engineers is followed by fabrication and erection by skilled mechanics, using the best equipment. As Fig. 1 shows, the piping arrangement of the new high-pressure section, at left, is simpler and less expensive than that of the older low-pressure section of the plant. In part this improved layout can be attributed to advancement in knowledge and methods of computing piping flexibility. Another factor is the adoption of something approaching the unit boiler-turbine system instead of the more elaborate multiple-ring-header system in the old boiler-house.

This simplification was acceptable because of greater confidence in the reliability of modern welded-piping construction as distinguished from flanged connections with inherent liability to joint trouble, especially where excessive bending moments are present. Both elements of improvement came as the result of close application to betterment of design principles. The change to a single-outlet superheater instead of the 2-outlet type on the older boilers also tended to simplify the piping.

At the time the old section was designed, methods of computing piping flexibility had not become so far advanced as they had ten years later for the new section, and designers were not so sure of their ground. Hence the layout in the old section contains extra-flexibility loops, later found not needed after flexibility analysis had progressed to a point where stresses and reactions could be computed with more certainty. The omission of unnecessary turns and loops not only effects a considerable reduction in first cost but, if the same size pipe is used in both cases, also results in an appreciable operating saving through reduced pressure drop. Thus a modest outlay for know-how in design can turn out to be a profitable investment.

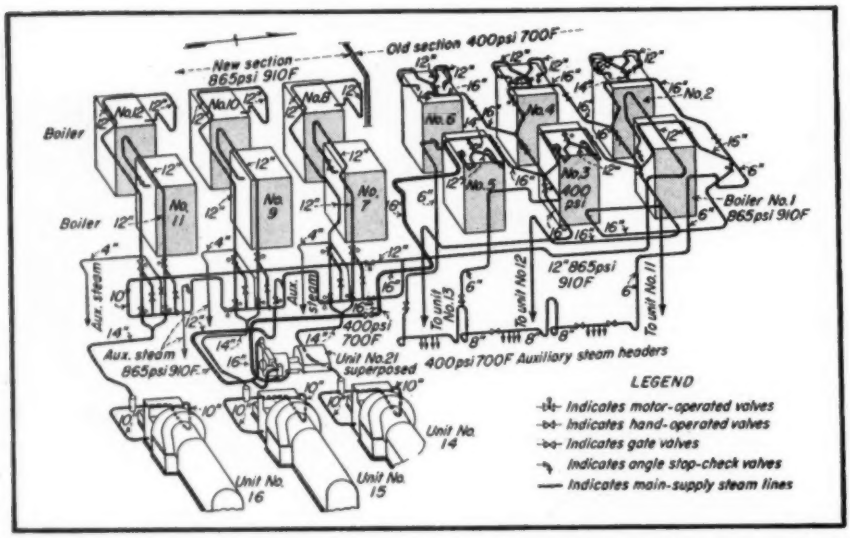


Fig. 1—Steam piping in old and new sections of Delray Station, The Detroit Edison Co. Simpler, less expensive system of newer section, left, is partly due to better methods of computing flexibility of high-pressure piping systems

Flexibility Analysis. One important service offered by piping fabricators is checking of layouts for adequate flexibility and for hangers and anchors properly placed to hold lines at temperature without objectionable stresses or transfer of load to equipment. Although a wide choice of methods is available for making such determinations, a rigorous analysis of anything beyond the simpler layouts is apt to prove difficult for those not well versed in the subject. Hence many are content with square-cornered approximations or ready-made chart solutions for preliminary layout, leaving to the fabricator's staff the more rigorous job of developing a final lay-

* Mr. Crocker is a member of several ASA, ASME and ASTM committees concerned with piping codes, specifications and standards. He prepared this article at the request and with the cooperation of the executive committee of Pipe Fabrication Institute. Part I appeared in October, 1946, POWER, pp 64–67.

out that is economical and sufficiently flexible.

Final calculations may be algebraic, graphical or grapho-analytical; or the problem may be solved with a model tester using small-scale tubing or rods and applying the laws of similitude for converting the results to a full-sized piping system. Mathematical solution is fairly simple where the pipeline between anchor points lies in a single plane, but a 3-dimensional problem often involves from three to six times as much work. The solution is further complicated where there are branch connections or more than two anchor points. Under these circumstances the alternate of model testing has definite advantages.

Part of a typical solution by the grapho-analytical method is illustrated in Fig. 2. This method involves sketches and area-moment diagrams in conjunction with algebraic tabulations from which the moments and reacting forces are obtained for the three planes. Since three forces exist and must be considered in respect to each of two planes, six bending-moment diagrams and tabulations similar to those of Fig. 2 are required. These six sets of results are then combined into three simultaneous equations to be solved for the three forces. The resisting moments at the end of the line are determined by substituting the values of these forces in the ordinates of the bending-moment diagram, as shown in the sketch below.

Application of the forces and bending moments to the pipelines is shown in the third sketch of Fig. 2. With this information in hand it is possible to combine bending and internal pressure stresses to determine total combined stress as prescribed in the American Standard Code for Pressure Piping.

To determine the flexibility of a single run of pipe with two anchor points, Fig. 2, by purely algebraic methods requires the solution of three or six simultaneous equations depending on the method used. Each additional side branch and anchor point increases the number of equations by three or six, and the amount of calculation work in-

TABULATION, Fz FORCE IN YZ PLANE

Case I. $EI\Delta z_c = \Sigma\ \psi_M R = 12{,}512.4F_Z \times 60 = 750{,}744F_Z$ up.
Case VIII(b). $\psi_{FYZ} 0.754R = 4{,}140F_Z \times 45.24 = 187{,}294F_Z$ up.
Case IX(c). $\psi_{MYZ} 0.637R = 7{,}994F_Z \times 38.22 = 305{,}542F_Z$ up.
Case I. $EI\Delta z_d = \Sigma\ \psi_d l = 24{,}647F_Z \times 138 = 3{,}041{,}245F_Z$ up.
Case II. $\psi_F \tfrac{2}{3} l = 9{,}522F_Z \times 92 = 876{,}024F_Z$ up.
Case III. $\psi_M \tfrac{1}{2} l = 8{,}876F_Z \times 69 = 612{,}458F_Z$ down.
Case I. $EI\Delta z_e = \Sigma\ \psi_d R = 25{,}293F_Z \times 60 = 1{,}517{,}550F_Z$ up.
Case VI(a). $\psi_{Fa} 0.624R = 4{,}109.6F_Z \times 37.44 = 153{,}863F_Z$ up.
Case VII(b). $\psi_M 0.363R = 23{,}534F_Z \times 21.78 = 510{,}406F_Z$ down.
Case I. $EI\Delta x_f = \Sigma\ \psi_d R = 25{,}293F_Z \times 60 = 1{,}517{,}550F_Z$ right.
Case VI(b). $\psi_{Fa} 0.876R = 4{,}109.6F_Z \times 52.56 = 216{,}000F_Z$ right.
Case VII(a). $\psi_M 0.637R = 23{,}435F_Z \times 38.22 = 895{,}670F_Z$ left.
Case I. $EI\Delta y_f = \Sigma\ \psi_d l = 5{,}968 \times 48 = 286{,}440F_Z$ right.
Case III. $\psi_M \tfrac{1}{2} l = 5{,}968 \times 24 = 143{,}220F_Z$ left.
Summation: $EI\Delta z = 6{,}069{,}398F_Z$ up; $EI\Delta y = 981{,}105F_Z$ right.

(1) $EI\Delta x = 1{,}211{,}710F_Y$ *right* $108{,}155F_Z$ right $5{,}952{,}834$ / $349{,}316$ / $6{,}302{,}150F_X$ left.

(2) $EI\Delta y = 386{,}574 + 635{,}269 = 1{,}021{,}843F_Y$ left; $981{,}105F_Z$ right; $1{,}211{,}530F_X$ right.

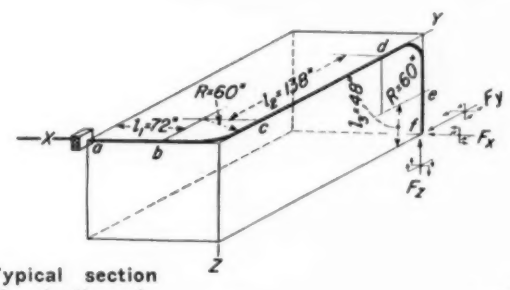
(3) $EI\Delta z = 981{,}873F_Y$ down; $6{,}069{,}398 + 629{,}403 = 6{,}698{,}801F_Z$ up; $108{,}265F_X$ down.

Substituting values of E, Δ, and I and letting deflections to the left and up be designated as positive, the following simultaneous equations are obtained:

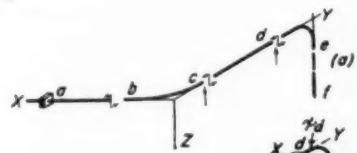
$E = 25{,}000{,}000,\ I = 361.5$ $\quad \Delta x = 0.647,\ EI\Delta x = 5{,}847{,}262{,}500$; $\Delta y = 1.270,\ EI\Delta y = 11{,}477{,}625{,}000$; $\Delta z = 0.530,\ EI\Delta z = 4{,}789{,}875{,}000$

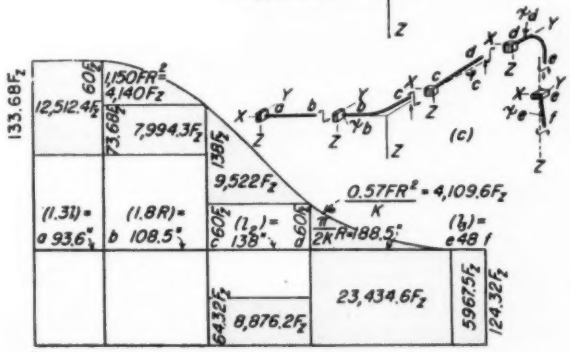
(1) $-1{,}211{,}710F_Y - 108{,}155F_Z + 6{,}302{,}150F_X = 5{,}847{,}262{,}500$
(2) $+1{,}021{,}843F_Y - 981{,}105F_Z - 1{,}211{,}530F_X = 11{,}477{,}625{,}000$
(3) $+981{,}873F_Y + 6{,}698{,}801F_Z - 108{,}265F_X = 4{,}789{,}875{,}000$
(1) $-1{,}211{,}710F_Y - 108{,}155F_Z + 6{,}302{,}150F_X = 5{,}847{,}262{,}500$
(2) $+1{,}211{,}710F_Y - 1{,}163{,}398F_Z - 1{,}436{,}644F_X = 13{,}610{,}252{,}000$
(A) $-1{,}271{,}553F_Z + 4{,}865{,}506F_X = 19{,}457{,}514{,}500$
(1) $-1{,}211{,}710F_Y - 108{,}155F_Z + 6{,}302{,}150F_X = 5{,}847{,}262{,}500$
(3) $\pm 1{,}211{,}710F_Y \mp 8{,}266{,}855F_Z \pm 133{,}607F_X = \mp 5{,}911{,}082{,}769$
(B) $-8{,}375{,}010F_Z + 6{,}435{,}757F_X = -63{,}820{,}269$
(A) $-8{,}375{,}010F_Z + 32{,}046{,}472F_X = 128{,}155{,}850{,}871$
(B) $\pm 8{,}375{,}010F_Z \pm 6{,}435{,}757F_X = \pm 63{,}820{,}269$
$+25{,}610{,}715F_X = 128{,}219{,}671{,}140$
$F_X = 5{,}010;\ F_Y = 20{,}870;\ F_Z = 3{,}855$

Fig. 2—Part of flexibility solution by grapho-analytical method for typical pipeline in space anchored at both ends, showing moments

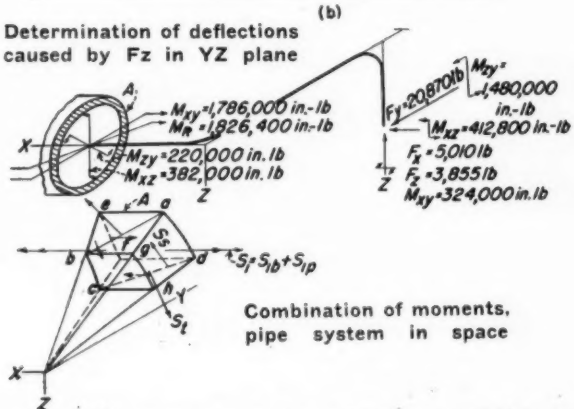


Typical section of pipeline in space anchored at both ends





Determination of deflections caused by Fz in YZ plane



Combination of moments, pipe system in space

Reproduced by permission from *Piping Handbook*, by Sabin Crocker, McGraw-Hill Book Co.

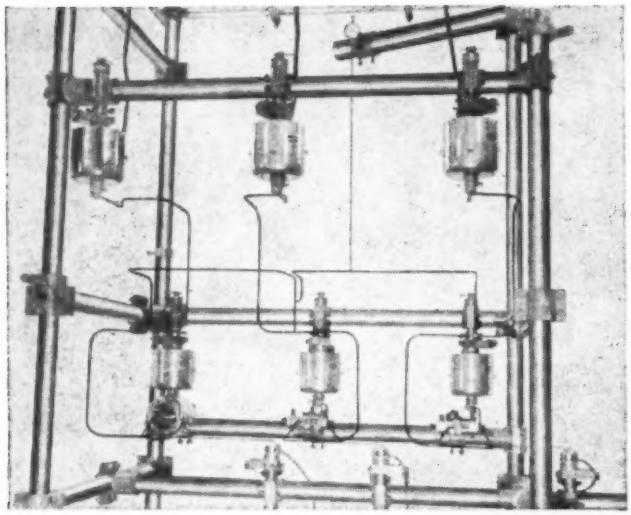


Fig. 3—Electrical model tester, which works on Wheatstone-bridge principle, is typical of specialized instruments available in the laboratories of piping fabricators

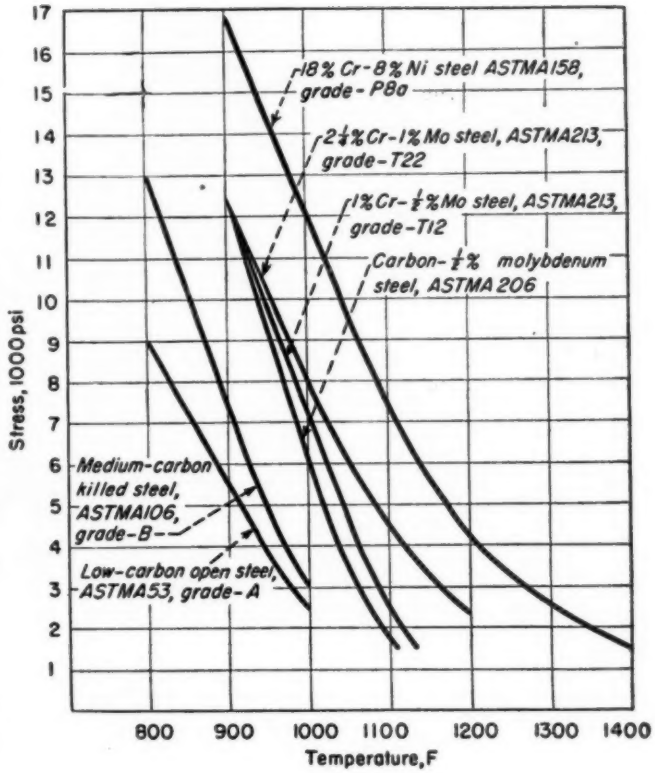


Fig. 4—Typical stress-temperature characteristics of several pipe steels for a creep rate of 1% in 100,000 hours. Designers use these to select appropriate material

creases almost in proportion to the square of the number of equations. The practical limit for a straight mathematical approach is about four points of fixation, involving the solution of nine or 18 simultaneous equations.

The difficulties have led to development of several varieties of model testers to measure reactions set up by given amount of displacement. Reactions and moments exerted by the model piping system can be measured in any one of several ways. Of these the following are in use: (a) weights supported on strings running over pulleys (b) calibrated spring balances and (c) electrical circuits operating on the Wheatstone-bridge principle. Such model testers, Fig. 3, are available in the laboratories of piping fabricators and others.

Metallurgical Problems. Progressive increases in steam pressures and temperatures over some 30 years from 200 psi and 400 F to pressures of 1000 to 2000 psi and temperatures in the 900- to 1050-F range, have been made possible by persistent work along metal-

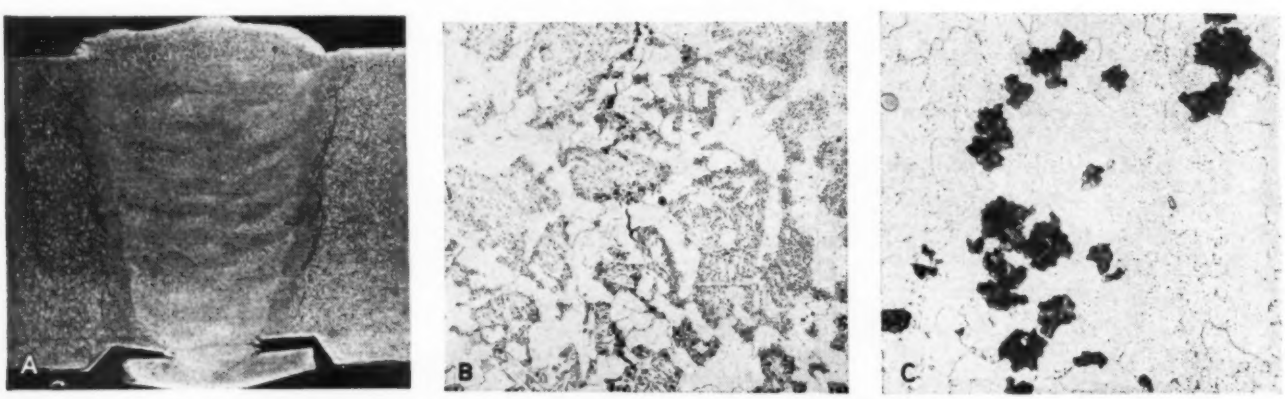


Fig. 5—Typical photomicrographs, taken after several years' service at elevated temperature, show several degrees of graphitization found in carbon steel and carbon-molybdenum steel pipe at the outer edges of zones affected by the heat of welding. A to D—Severe case of Type I continuous segregated graphite at outer edges of heat-affected zones in welded joint of Springdale high-aluminum A158 carbon-molybdenum steel is similar to that which failed in service after some 40,000 hours at average operating temperature of 935 F with swings to 1000 F or higher during initial operation. A—Cross-section of welded joint approximately full size, showing that a severe case of intergranular graphitization in heat-affected zones adjacent to the weld is apparent at little or no magnification. (Photo, courtesy R W Emerson). B—Small section of heat-affected zone magnified 50 times to show how graphite can segre-

lurgical lines. Cast-iron fittings and valves good enough for 200 psi and 400-450 F were unsuited to the more severe conditions. Similar problems were encountered in the oil industry and other process work.

In advancing through the temperature range from 500 to 700 F much attention was given to developing carbon-steel products suitable for temperatures higher than cast or wrought iron could stand. In obtaining sound cast-steel fittings and valve bodies, troubles were encountered that were not experienced when working with cast iron. These difficulties were gradually overcome. Later, when operating temperatures were pushed into the range of 750 to 850 F, consideration had to be given to silicon-killed carbon-steel pipe and a better grade of steel castings, in some cases containing small amounts of alloying elements.

At this stage of the development, plastic flow of metals under load at elevated temperature came into the picture, and a whole set of new data had to be collected for each material from laboratory creep tests at a series of loads and temperatures. Through this collection of creep data it became possible to predict the rate of permanent deformation to be expected for any particular material under a given set of conditions.

Depending on the application and expected life of the equipment, the designer then chose a material and working stress that would give a creep rate not to exceed 1% in 100,000 hr or 1% in 10,000 hr as the case might be. For example, a creep rate as low as 1% in 100,000 hr might be necessary for long-life steam-power piping, whereas 1% in 10,000 hr might be more economical for relatively short-life equipment in the oil industry.

For convenient use, results of laboratory creep tests can be plotted as shown in Fig. 4. Data of this sort are useful in selecting an appropriate pipe material and also are the basis on which the code values for allowable stresses are set.

Rate of creep, however, is only one criterion for judging satisfactory performance of metals at elevated temperatures. Other forms of deterioration under prolonged exposure to stress at high temperatures also have to be taken into account. Working stresses in flange bolts of 30,000 to 60,000 psi demand alloy steel of great strength and endurance. Among the difficulties experienced with piping-system materials are strain aging, embrittlement, intercrystalline cracking and graphitization.

Embrittlement of Bolting. The tendency to embrittlement in headed carbon-steel bolts became manifest when operating temperatures reached 600 F, with brittle failures under the heads a common experience. This led to the adoption of alloy-steel bolt studs for high-temperature piping.

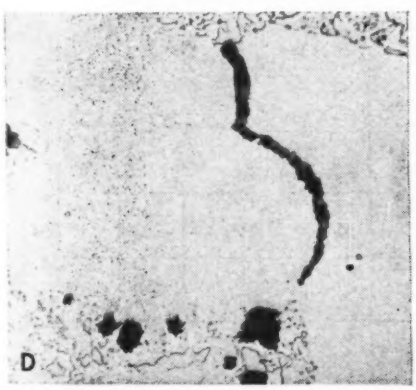
To seat the gasket properly when making up a flanged joint, bolts often have to be pulled up to tensile stresses of 30,000 to 60,000 psi. After the line is subsequently brought up to temperature, the bolts tend to relax so that the ultimate working stress they can support over long periods of time may be of the order of 16,000 psi at 650 F or 8000 psi at 950 F. Bolting must be designed so residual gasket compression under these circumstances is still several times the pressure in the line, especially if a bending moment exists at the joint.

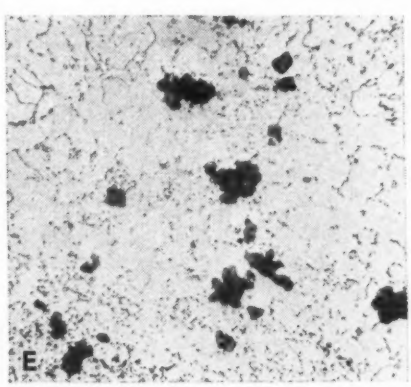
With temperatures of 700 F or higher, trouble was again experienced with embrittlement of some types of alloy steel when used as bolt studs, particularly of straight-nickel and nickel-chromium material without other alloying elements. As a result of these troubles several other alloy bolting materials containing moderate amounts of additional elements have been developed that are better suited for high stress at elevated temperature for long periods of time. Chromium-molybdenum bolt steels, often with tungsten or vanadium added, have performed well at temperatures up to about 950 F.

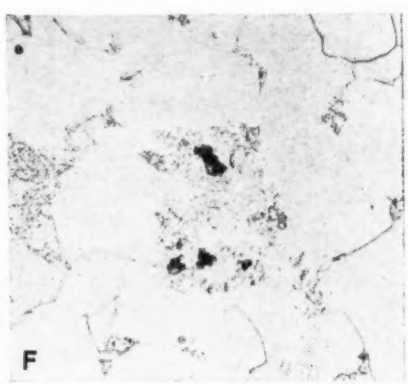
Room-temperature impact values of even the best available bolting steels can be expected to be materially reduced after five to ten years' service at 850 to 950 F. Heating to 1100 F and quenching in oil after holding the temperature for some time has been found effective in restoring original impact strength.

For temperatures of 1000 to 1100 F, tungsten-chromium-vanadium steel has been used with good results where corrosion is not an item of major concern.

(*Continued on page* 156)







gate to form a plane of weakness. (Photos B to F, courtesy I A Rohrig). C—Small section of heat-affected zone magnified 500 times to show how graphite can form within the grains. D——Small section of heat-affected zone magnified 500 times to show how graphite can form along the grain boundaries. E—Type II is not so serious as Type I since the graphite has not segregated to form a continuous plane of weakness, showing moderate amount of scattered graphite found in welded joint by field sampling with a weld prober in Grade B silicon-killed A106 carbon-steel pipe in service 45,586 hours at about 835 F. Magnification 500. F—Type III shows slight amount of random graphite found in welded joint by field sampling with weld prober in high-aluminum A158 carbon-molybdenum pipe after 35,899 hours at about 895 F. Magnification 500 as printed on this page, having been reduced from 1000 during engraving process

How Does Supercharging Affect Diesel-Engine Performance?

Ralph Miller of Nordberg Mfg Co explains the relations between supercharging pressure and engine temperatures and pressures; he tells how to determine the safe limits for capacity increase in both noncooled and intercooled designs*

► SINCE THE DIESEL FIRST became a practical prime mover, untold hours and dollars have been spent to increase its work-to-displacement ratio. This can be done by either increasing rotative speed or raising mean effective pressure. Here we deal with the latter.

In the last 30 years improved materials, design and manufacture have made possible a bmep increase of about 15 psi, from 60 to 75 psi, for heavy-duty high-service-factor operation. At this mep and 86% volumetric efficiency, there is almost 100% excess air for combustion. But higher mep's with resulting excess-air reductions cause combustion temperatures to rise beyond safe limits for today's materials.

Four paths are open for further increases in work-displacement ratio: (1) improving combustion efficiency, thereby converting more heat into work without raising temperature (2) improving materials and cooling methods to stand higher temperatures (3) admitting greater weight of air to cylinder or (4) reducing temperature of charge before compression. Let's examine (3) and (4) which offer greatest possibilities:

Weight of air admitted can be increased by raising intake pressure above atmospheric, that is, by *supercharging*. If this can be done without increasing charge temperature at start of compression and without thermal-efficiency loss, mean indicated pressure and indicated horsepower go up in proportion to increase in *absolute* pressure at start of compression. If supercharging pressure is 4 psig, absolute pressure at start of compression is 4 + 14.7 = 18.7; the gain in mean indicated pressure is 18.7/14.7 = 1.27 or 27%.

In Fig. 1, solid lines trace a theoretical indicator diagram for an unsupercharged engine as in the following:

Mean indicated pressure, psi	94.5
Compression ratio	13.5
Initial compression pressure, psia	14.7
Final compression pressure, psia	468
Maximum combustion pressure, psia	765
Cutoff, % total volume (end of constant-pressure combustion in % piston-displacement volume plus clearance volume)	11.2
Compression exponent	1.33
Expansion exponent	1.45

When this engine is supercharged to 4 psig and operated with same thermal efficiency, compression ratio and ratio of maximum combustion pressure to compression pressure are retained. This results in compression pressure of 595 psia (468x1.27), combustion pressure of 973 psia (765x595/468). Constant-pressure combustion remains 11.2%.

The mip, Fig. 1, may be computed by the usual formula, which shows that when compression volume ratio and ratio of combustion to compression pressure are kept constant, mip increases directly with initial compression pressure, P_1. It may be shown also that if temperature of the charge at start of compression (T_1) is kept constant, tem-

* Condensed from a paper presented at the 1946 Midwest Power Conference

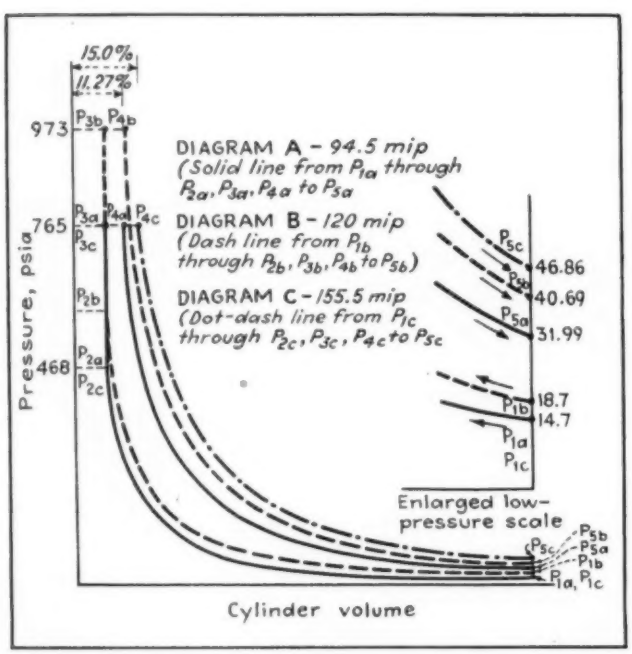


Fig. 1—Theoretical indicator diagrams for an unsupercharged engine, a unit supercharged to 4 psig, an unsupercharged engine with its intake-air temperature reduced

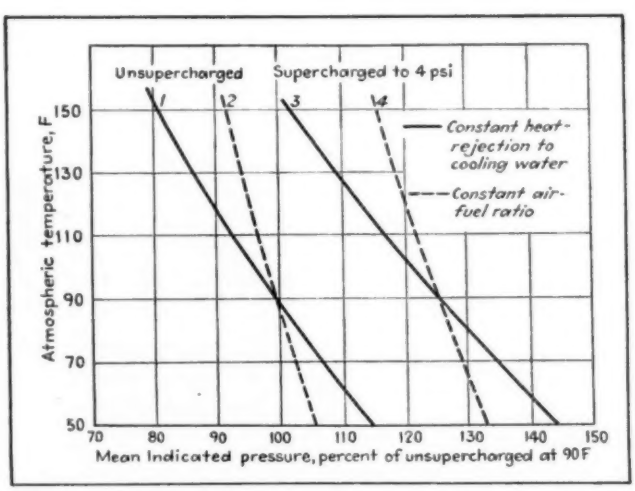


Fig. 2—Change in load with change in intake-air temperature, for unsupercharged and supercharged engine, with either the heat-rejection or air-fuel ratio held constant

peratures throughout the cycle in the two diagrams are identical.

This means that temperature of internal-engine surfaces, heat flow to the cooling water, and exhaust temperatures are also identical. But since ihp of the supercharged engine is up 27%, its *rate* of heat flow to cooling water (Btu per ihphr) is only 79% of heat flow of unsupercharged engine. On a basis of bhp, gain in output is higher, because mechanical efficiency is better, and heat flow to cooling water per bhphr is only 76% of that of unsupercharged engine.

The effects of supercharging to 4 psig under the conditions stated can be summarized as follows:

Increase in weight of air	27%
Increase in indicated hp	27%
Increase in brake hp	32%
Increase in compression pressure	27%
Increase in combustion pressure	27%
Reduction in fuel consumption	2.5%
Change in cycle temperature	None
Change in air-fuel ratio	None
Reduction in heat flow to cooling water, Btu per bhphr	24%

This gives an idea of what happens when weight of air admitted to cylinder is increased. What happens when temperature of charge is reduced before compression? For simplicity, assume temperature reduction that produces, at atmospheric pressure, same increase in air weight as supercharging to 4 psig at constant temperature, namely 27%. This requires 140 F reduction.

If we imagine the supercharged engine in a room charged to 4 psig with temperature 90 F, the unsupercharged engine, to operate with same air density, would be in a room with pressure 14.7 psia and temperature −50 F. Both engines would take in on the suction stroke, and have available, for combustion, 27% more air by weight than the standard engine operating at atmospheric pressure and 90 F. The three indicator diagrams of Fig. 1 show how operation under these three sets of conditions differs; before comparing them, let's look at temperatures.

SUPERCHARGING LIMITS

One factor limiting mep in unsupercharged engines is temperatures of engine parts and problem of removing heat. If amount of supercharging is limited to that which gives same cycle temperatures and same total heat flow to cooling water, rating is as conservative as that of unsupercharged engine.

Temperature increase of the charge during combustion is a function of thermal efficiency and air-to-fuel ratio. For example, heat of one lb of fuel (about 19,000 Btu) produces a higher gas temperature when burned with 20 lb of air than with 30 lb. Assuming an initial compression temperature of 660 F abs (200 F) for Fig. 1 diagrams, maximum temperature at end of constant-pressure combustion (P_4) is determined by formula: $PV = WRT$. For unsupercharged engine, maximum temperature is $T_4 = 3720$ F abs; for supercharged engine it is 3720 F, also.

When unsupercharged engine operates with air intake at −50 F to increase air density by 27%, initial compression temperature is only 520 F abs (60 F). Increasing load 27%, as with supercharged engine, gives cutoff of 12.65%, and maximum combustion temperature is 3320 F.

Thus, although the engine operates at same air-fuel ratio as the unsupercharged unit, cycle temperature is much lower. The reason is that maximum temperature is sum of initial temperature and temperature rise due to combustion; the cooled engine's initial temperature is 140 F lower.

Calculations show that, with 140-F reduction, load could be increased 65% (to 155.5 mip) without exceeding cycle mean temperature of conventional unsupercharged engine at 94.5 mip. This cooled engine compares with uncooled atmospheric engine thus:

Increase in weight of air	27%
Increase in indicated hp	65%
Increase in brake hp	75%
Increase in compression press	None
Increase in combustion press	None
Reduction in fuel consumption	5%
Change in cycle temperature	None
Lb air per lb fuel reduced	23%
Heat flow to cooling water, in Btu per bhphr, reduced	43%

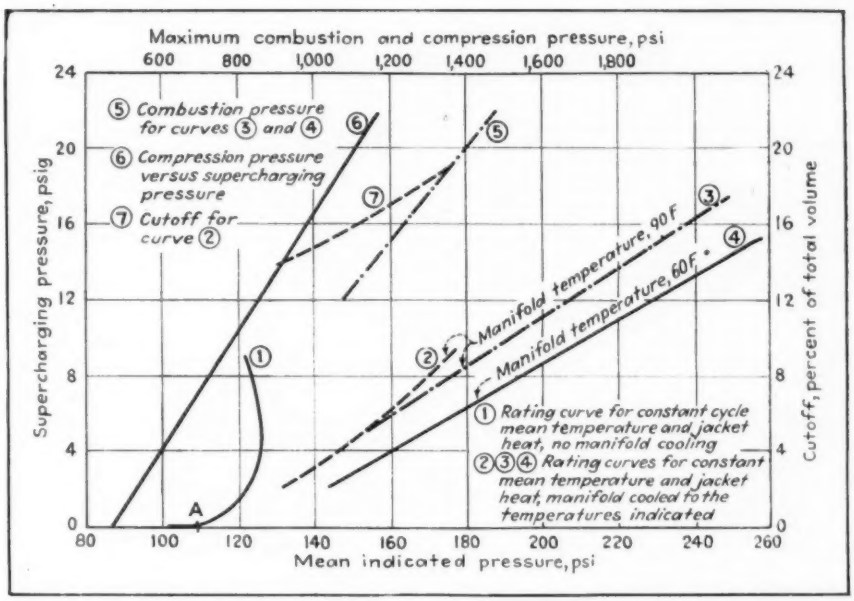

Maximum combustion and compression pressure, psi
600
800
1,000
1,200
1,400
1,600
1,800
Supercharging pressure, psig
Cutoff, percent of total volume
⑤ Combustion pressure for curves ③ and ④
⑥ Compression pressure versus supercharging pressure
⑦ Cutoff for curve ②
Manifold temperature, 90 F
Manifold temperature, 60 F
① Rating curve for constant cycle mean temperature and jacket heat, no manifold cooling
②③④ Rating curves for constant mean temperature and jacket heat, manifold cooled to the temperatures indicated
A
Mean indicated pressure, psi

Fig. 3—Rating curves for constant-cycle mean temperature and jacket heat, with and without manifold cooling, plus curves giving combustion pressures, compression pressure versus supercharging pressure, and cutoff in percent

This example of intake-air cooling is not practical for standard designs but illustrates intake-temperature effect on engine capacity. This is further shown in Fig. 2, which plots effect of intake-air temperature on engine capacity within practical ranges, for both supercharged and unsupercharged engines. Each type has two curves, one showing effect if air-fuel ratio is held constant; the other, if cycle mean temperature is kept constant.

These theoretical comparisons give an insight into supercharging's practical side and the reason for cooling intake air. All supercharging systems "superheat" as well. That is, compressing air to the 4 psig of our example heats it to about 140 F, 50 F above 90-F room temperature. Thus while gain due to pressure is about 27%, this is offset by a loss of about 16% resulting from the temperature increase, and the *net* increase drops to about 11% in mip, or about 13% in bhp.

But by overlapping exhaust and inlet-valve timing so hot residual gas is blown out of clearance volume and replaced with cooler fresh air, charge temperature is reduced about 30 F at full load. Also air is heated less during suction stroke in supercharged engine.

Fig. 3 shows net results of pressure and temperature effects when supercharging a 4-cycle diesel. Curve 1 represents an engine with same total heat flow to cooling water and same internal surface temperatures as unsupercharged engine at normal rating, designated 100. As supercharging pressure on this en-

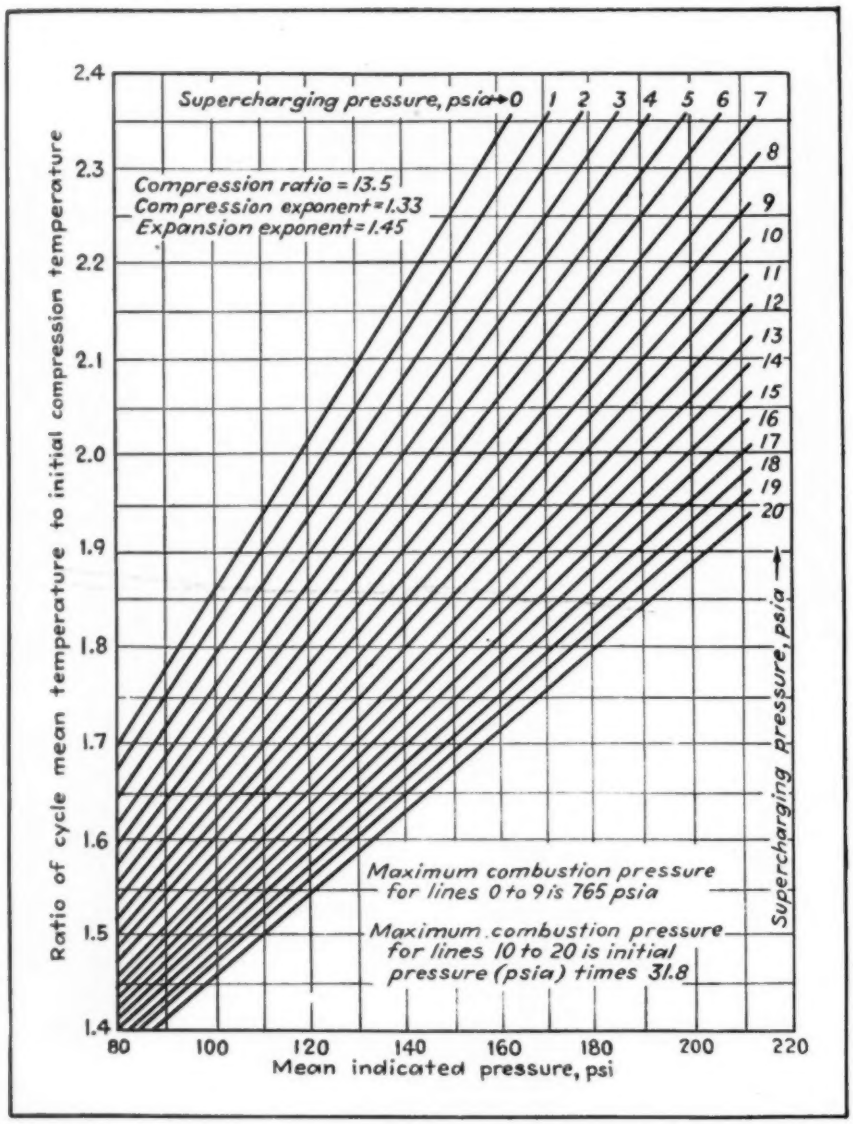


Fig. 4—Constant cycle-mean-temperature lines, plotted against mean indicated pressure for various supercharging pressures, permit ready determination of effect on engine output resulting from changing initial compression temperature

Table I—12x14-In. 6-Cylinder Engine at 600 Rpm

	Buchi Supercharged					
	Noncooled			Intercooled		
Brake mean effective pressure, psi	80	105	120	120	126	147
Mean indicated pressure, psi	100	128	144.5	144.5	151	174
Brake horsepower	576	756	864	864	907	1060
Indicated horsepower	720	921	1040	1040	1087	1253
Fuel consumption, lb per bhphr	.386	.375	.377	.371	.3705	.376
Fuel consumption, lb per ihphr	.309	.313	.313	.308	.308	.317
Total Btu per min (HHV-19600)	72,500	92,700	106,500	104,500	110,000	130,000
Heat to cooling water, B.u	12,000	12,300	14,500	11,700	12,300	14,500
Heat to cooling water, % of total	16.6	13.3	13.6	11.2	11.2	11.15
Brake thermal efficiency, %	33.7	34.7	34.4	35	35	34.5
Supercharging pressure, psig	0	3.45	4.2	4.075	4.38	5.75
Air-intake temperature F	90	140	147	90	90	90
Initial compression temperature, F	675	671	677	621	619	617.5
Ratio T_m to T_i	1.895	1.91	2	2.06	2.07	2.19
Mip (calculated)	100	127	.....	.....	151	.....
Total weight of air, lb per min	101	165	170	184.2	188	200
Weight of air retained in cylinder, lb per min	101	129.5	134	145	148	158.5
Weight of fuel, lb per min	3.71	4.76	5.46	5.33	5.6	6.65
Lb of air per lb of fuel	27.2	27.1	24.5	27.2	26.4	23.8
Total volume of air, cfm	1395	2210	2270	2460	2510	2675
Heat removed from air, Btu per min	.....	.....	.....	2500	2750	3700
Heat removed from air, Btu per min per hp	.....	.....	.....	2.90	3.03	3.5
Btu % of total cooling water + air	16.6	13.3	13.6	13.6	13.6	14.2

gine increases, rate of loss due to air heating eventually exceeds rate of gain due to pressure, indicating maximum output at about 5-psi supercharge.

This analysis leads to the conclusion that to obtain maximum use of equipment, supercharged 4-cycle engines should be equipped with air intercoolers to reduce temperature of supercharging air to original room temperature or lower. Engine tested to produce data for Curve 1 was fitted with an air cooler to return temperature of supercharging air to room temperature and further tests gave Curve 2 values. At 4-psig supercharge pressure, mip increased from 123 to 146 psi, 18.5%.

INTAKE-COOLING CHART

For ready determination of effect of cooling the supercharging air, Fig. 4 plots lines of constant cycle mean temperature against the mip for supercharging pressures up to 20 psi. If pressure remains constant and only initial compression temperature is changed, any mip read on a pressure line at constant-cycle mean temperature has also constant heat flow to jackets and the same internal temperatures.

Consider, for example, a supercharged engine at 130 mip with air manifold temperature of 145 F, and 4 psig. Ratio of mean to initial temperature is 1.935. With 90-F blower intake temperature, initial compression temperature is 665 F, which represents atmospheric temperature (abs) plus heating in blower (55 F) and in cylinder (60 F). Mean temperature is $1.935 \times 665 = 1287$ abs. Cooling this air to 90 F in manifold, T_i becomes 610 and the T_m/T_i ratio is 1287/610 or 2.11. Mip for this ratio on the 4-psig line is 156 psi.

Table 1, showing test data of a 12x14 6-cyl engine, gives practical application of these supercharging principles. When air is cooled at 120 bmep, fuel consumption drops from 0.377 to 0.371 lb per bhphr, and drop in Btu to cooling water is about equal to Btu removed from air by cooling. First stationary, intercooled turbocharged engine installed in U. S. (POWER, July, p 81) shows increase of 20 bmep (from 110 to 130) as result of intercooling, without changing supercharging pressure.

Intercooling combined with supercharging has made it possible to increase bmep by about 55 psi in five years, compared to 15-psi gain in the past 30 years. Intercooling is now practicable only where water is available at temperatures not over 80 F. In the transportation field, where air is the only practical cooling medium, intercooling cannot be used with present methods.

Recent installation by C W Colby, engineer and designer, promises to answer many controversial questions on radiant heating. The system heats the A O Smith Corp's new plant at Kankakee, Ill.

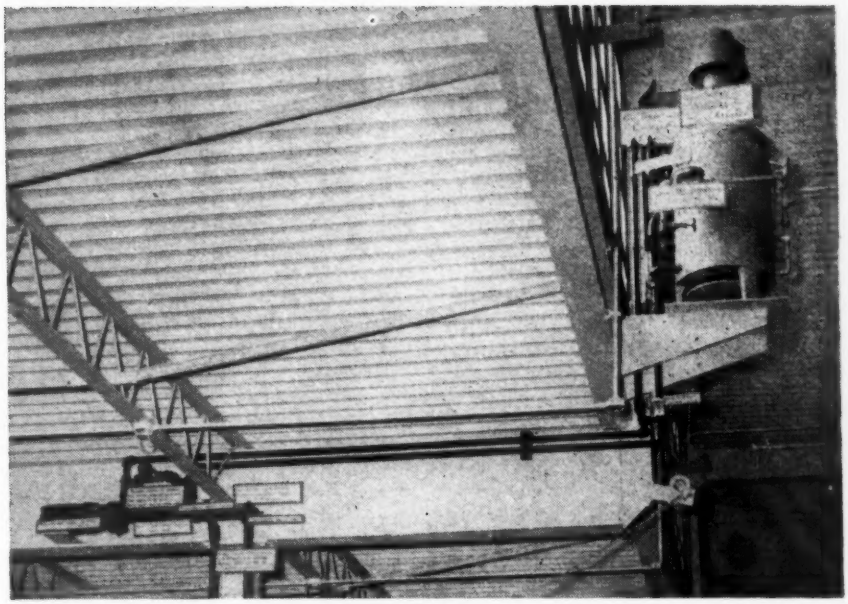


Fig. 1—The gas-fired heaters mount on platforms immediately above central aisle. Heaters will be vented to outdoors if they increase building humidity appreciably

Laboratory to Study Radiant Heating

▶ THIS SYSTEM WAS LAID out to heat a new factory adequately and, at the same time, to provide a system that could be studied and tested from every angle of the radiant-heating principle. The building, largely a one-story structure, is 1200x315 ft. Total floor area is 415,188 sq ft; ground floor contains 381,750 sq ft for manufacturing and offices; mezzanine, 10,650 sq ft for laboratories and 22,788 sq ft for offices.

Highlights of the system are: (1) decentralized units instead of a central plant (2) steel and copper tubing as well as wrought-iron pipe (3) thermocouple wells in the ground under the floor slab (4) flowmeter connections in headers to measure water flow.

Complete system consists of 40 miles of piping, and circulates 15,000 gal of water twelve times an hour. Heat is furnished by 120 individual natural-gas-fired water heaters fitted with modulating control, Fig. 1. Piping is wrought iron ranging from ¾ to 2 in.; copper from ⅜ to 1 in.; and ⅝-in. Bundy steel tubing. Use of these materials was dictated by engineering logic, necessity, and the desire to experiment and learn the answers to many questions still confronting the radiant-heating industry.

The plant is divided into 48 bays, each 25 ft wide running across the building. On either side of a concrete runway, which cuts the bays in half, lie the heating pipes for that area. One gas-fired heater serves each half bay. About 80% of the piping is grid construction. Some grids have 2-in. headers 140 ft long, and 1½-in. laterals 20 ft long, Fig. 2, while others consist of 20-ft headers and 140-ft laterals. Center-to-center dimensions range from 4 ft to 8 in. For purely experimental purposes one grid is laid out with 1¼-in. laterals 250 ft long, fed by 2-in. wrought-iron headers, an unusual design.

Grid construction has advantages in

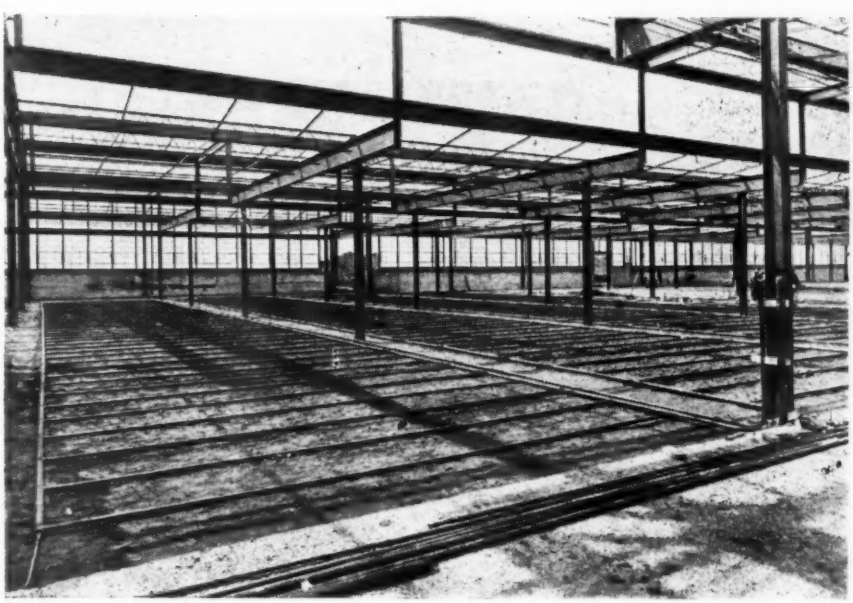


Fig. 2—Grid construction consists of 2-in. headers 140 ft long with 1¼-in. laterals 20 ft. long. Spacing varies according to calculated rate of heat loss

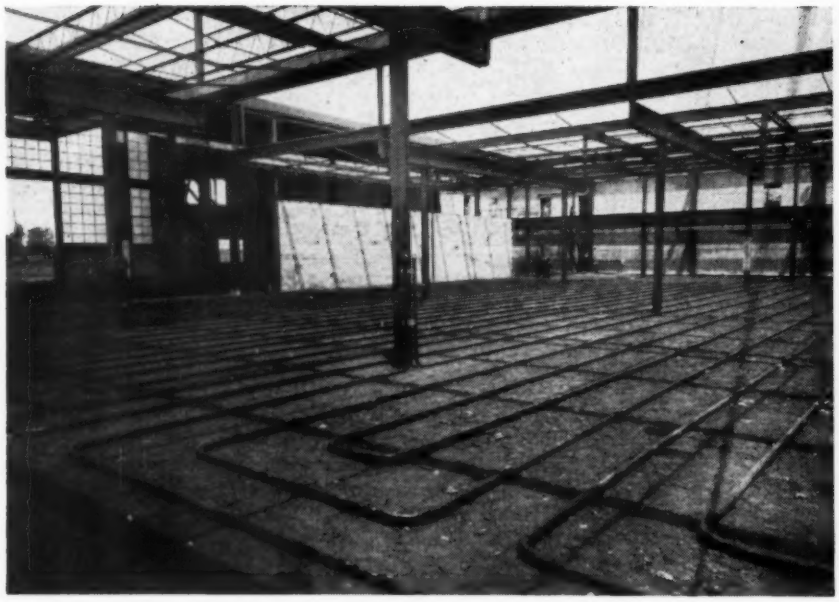


Fig. 3—In north end of plant, construction consists of 2-in. wrought-iron pipe on 36-in. centers in a continuous coil terminating at foremost building column

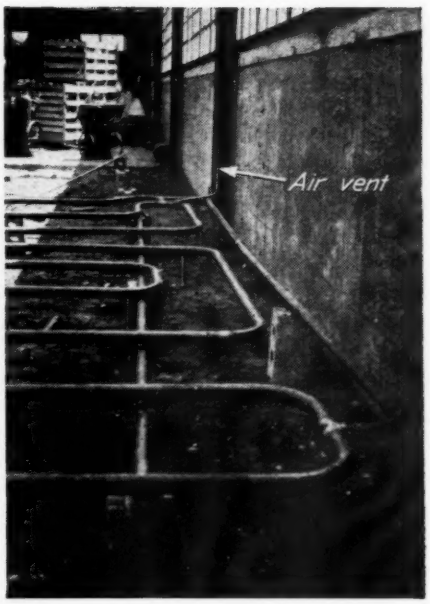


Fig. 4—Iron pipe used in combination grid and continuous-coil construction

some locations because it permits: (1) adding new laterals and header extensions as needed for future changes in floor arrangement and foundations (2) mass production of headers and laterals and possibility of making many welds at point of manufacture more easily than on the job (3) use of random pipe lengths, a worth-while economy.

Remainder of ground floor, 20%, uses a combination grid and continuous-coil construction, Fig. 3. Some headers feed continuous coils to break the flow circuit into several paths, Fig. 4, because this method reduces flow resistance so that it comes within the capacity of the circulating pumps and provides against later changes in floor arrangement and foundations. In one area, surrounding a large furnace in which the temperature will exceed 1600 F, a single continuous floor coil is installed to determine heat-transfer rate through the concrete slab. Main-floor piping lies directly on soil grade with a covering of heavy wire mesh. Latter serves as reinforcing for the 4-in. concrete-slab overlay, Fig. 6. Air-vent lines from each grid section run to adjacent building columns for routine checking, Fig. 4.

Ground-floor offices are equipped with wrought-iron floor grids and auxiliary piping in the ceiling near exposed windows, which adds radiating surface to both ground floor and mezzanine. Heating of the latter was completed by adding copper tubing to the ceiling in both grid and continuous-coil construction. The $\frac{3}{8}$-in. copper tubing, Fig. 5, fastens to the scratch coat of plaster on 4-in. centers at the outside exposure, changing progressively inward to 5-, 6-, 8- and 10-in. centers as required surface decreases near the building's inner walls.

Floor area in the lobby uses wrought-

Fig. 5—Copper tubing imbedded in second plaster coat of mezzanine ceiling. Spacing increases toward inner wall

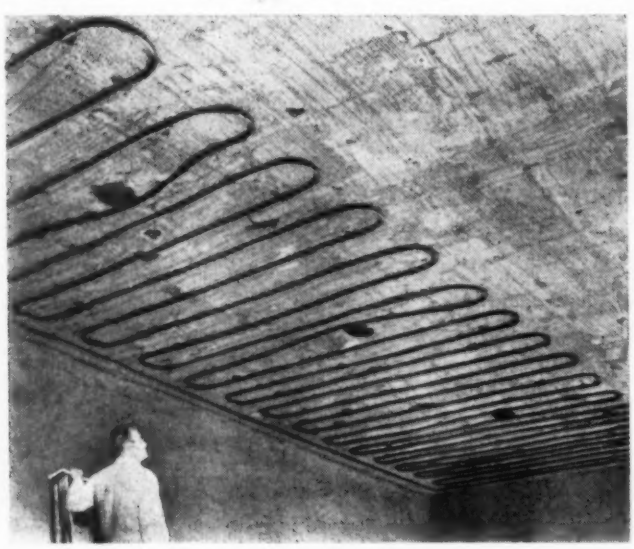
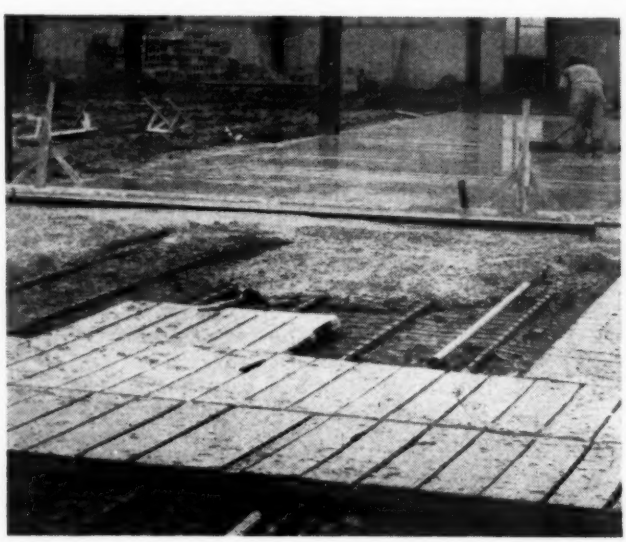


Fig. 6—Iron-pipe grid uses $1\frac{1}{4}$-in. laterals on 24-in. centers and 2-in. headers. The grid rests directly on the earth grade



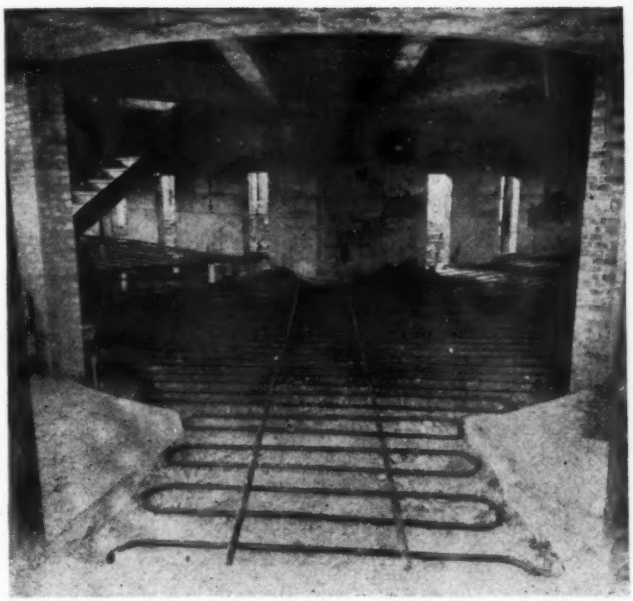


Fig. 7—Wrought-iron grid of oval laterals suits circular construction of the entrance lobby.

Fig. 8—This lobby has added heating surface of Bundy tubing in continuous coil embedded in the ceiling plaster near the window exposure

iron grid construction with individual loops welded to the headers, Fig. 7. Exposed area in the ceiling is fitted with continuous-coil Bundy tubing for experimental purposes, Fig. 8.

In the mezzanine appliance laboratory, 5/8-in. Bundy tubing is installed in 100-ft loops with center-to-center distances varying from 6 to 12 in. depending upon estimated rate of heat loss, Fig. 9. Both headers hang under and at one end of the mezzanine. Tubing, in grid construction goes the full length of the area and loops back to the discharge header. Each end of the loop connects to its respective header with a packed-pipe fitting to facilitate disconnecting a section here and there if heating surface is too great, or some particular point must be drilled for a machine footing.

Gas-fired heaters, Fig. 1, connect to each radiating panel through a circulating pump. Manual valve and bypass at the pump adjusts amount of recirculation or hot-water blending. System uses ten outside master thermostats, each of which controls 10 to 15 submaster units in the building zones. Heater output of 190,000 Btu per hr is calculated to maintain 140-F water at a −10 F outside temperature to hold floor at 85 F and ambient air at 65 F.

The system is flexible and no serious problem should arise if one or two bays are shut off during floor rearrangement. One person, acquainted with only a simple water heater, can service the entire installation. Blueprints show exact location of every weld, joint, bond, header and lateral; each pipe-run outline is painted on the concrete floor. Results of the experiments will be publicized for engineers interested in following developments of radiant-heating design.

Fig. 9—Bundy tubing, in 100-ft loops, for the testing laboratory. Tubing terminates at one end of mezzanine where packed fittings connect it to headers

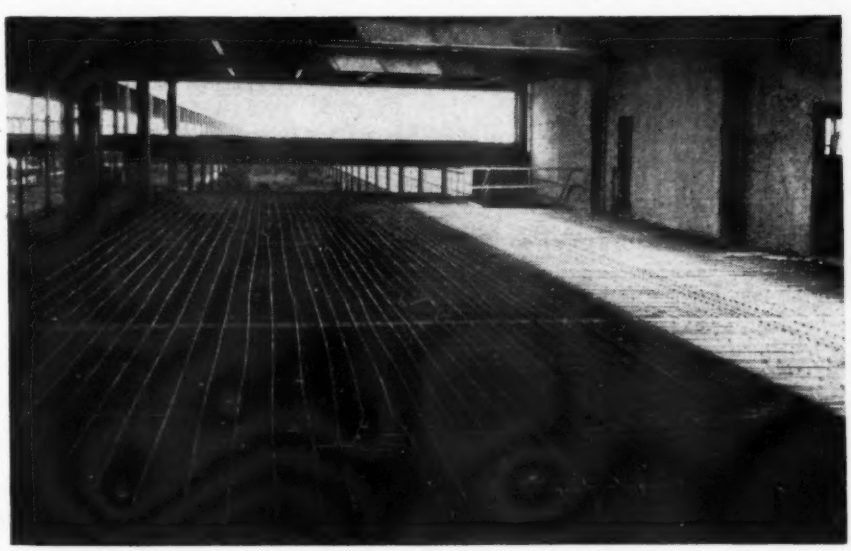
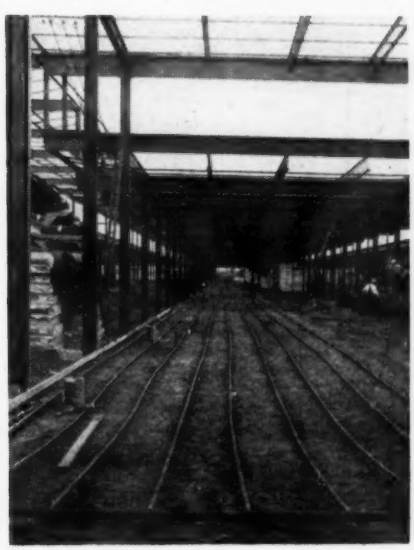


Fig. 10—Grid fabrication has 250-ft laterals of 1¼-in. wrought-iron pipe



THE FUTURE OF ATOMIC ENERGY

Cooperative effort by scientists, engineers and social scientists appears to offer greatest hope of early success in solving the problem of power from atomic energy for peace. An integrated survey of the problem's nature has been made

▶ LIKE ATOMIC ENERGY, ordinary fire was once man's scourge, destroying countless forests, homes and even people. But just as his native intelligence changed this scourge to a boon, so he will likely subjugate atomic energy but on a much more condensed time scale. Atomic energy is now costly in man-hours, but applying our accumulated know-how should decrease expense rapidly to the point where large installations become economical.

By the time atomic energy becomes a major source of electric power it may also be able to replace much of the fuel for heating. This study concentrates on the production of electricity from atomic energy.

GEOLOGICAL APPROACH

Uranium is not a rare element. It is commoner in the earth's crust than silver, antimony and mercury combined. Thorium, also usable in atomic-power plants, is even more abundant.

Yet abundance does not mean easy availability. Uranium is locked up mostly in igneous rocks where at times it is found somewhat concentrated in pegmatites (coarse granites occurring in dikes and veins). Primary deposits do not contain enough uranium to permit commercial exploitation now. The richer deposits have been formed through erosion of large volumes of igneous rock and subsequent concentration by surface waters. These natural concentrations must be more than a thousandfold before 5 to 20 lb of uranium per ton can be obtained—the lowest economical limit at present.

New uranium discoveries can be expected to diminish in size and number. However, a generation or so hence, if we have to develop medium- and low-grade ores, it will not be a catastrophe because uranium has an intrinsic-energy worth far greater than the price of gold.

The more acidic light-colored igneous rocks, such as granite and rhyolites, have been known to contain 10 to 20 grams of fissionable elements per ton (20 to 25% uranium, the rest thorium) while the more basic and generally older, darker igneous rocks, such as basalt, usually contain 3 to 8 g per ton.

This means the world now has a huge fuel reservoir for power production. If 10 g of fissionable material in a ton of granite were extracted and "reacted," resultant power would be equivalent to more than 40 tons of coal. Since granite is one of the commonest rocks, the supply of low-grade ore seems to be nothing to worry about.

At present, uranium mining cost should be about $2 to $5 per lb metal to compete with existing sources. Since use of uranium in a pile requires scrupulous purity, cost of required additional refining may raise total charge to the power-producing plant to $5 to $10 per lb. When present rich and limited ore bodies are exhausted, fissionable-material costs are likely to go up gradually. Allowing expenses of several dollars per gram (1 lb equals 454 g) it should not be difficult to work out ways to extract fissionable material from granite or other low-grade large-volume sources.

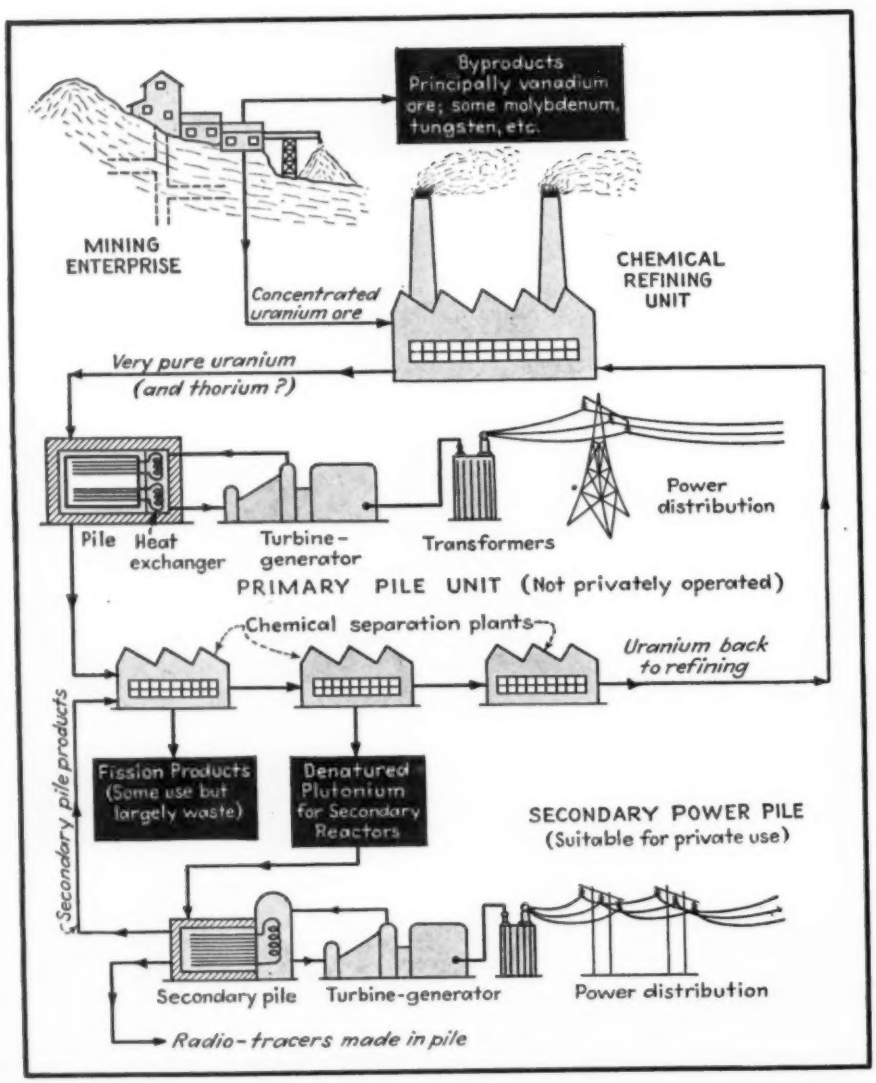


Fig. 1—Idealized atomic-energy industry in 195X, based on type of organization envisioned by the control plan offered by United States to United Nations' Atomic Energy Commission

IN POWER PRODUCTION

This is *Power*'s digest of a study prepared as a project of the Carnegie Endowment on Atomic Energy. This organization, represented at the University of California by Prof J B Condliffe, in cooperation with the Northern California Association of Scientists, called together a group to consider the social impact of atomic energy. Material presented in the first four meetings of this informal committee was selected, checked and analyzed.

The work does not presume to be authoritative, but is merely an analysis of the information available at present, put in a form usable by research workers and administrators in nontechnical fields. Many members of the group, both at the University and in various industries, have been very helpful in the preparation and criticism of the original manuscript and of this digest.

As will be seen later, a cost of several dollars per gram would barely affect the power cost, assuming that most fissionable materials introduced into a power pile would eventually be transformed into energy.

New fuel resources from energy-yielding mineral deposits will be sufficient to carry the human race through a great many centuries to come.

THEORETICAL APPROACH

The basic processes going on in a watercooled pile, as at Hanford, are not greatly different from those that would go on in a power pile at 1500 F using some other heat-exchange fluid. The same may be said for the chemistry of the separation.

Briefly, a neutron, preferably a slow-moving neutron, combines with the nucleus of an atom of Uranium 235 or Plutonium 239 (Pu 239) atom. The nucleus then splits into two plus-charged nuclei of lighter atoms, which fly apart at tremendous speed. Also, according to the Smyth Report, one to three neutrons are released at high velocity. Some hit and split other uranium or plutonium atoms. The high-speed fission fragments are rapidly slowed down by collision with neighboring atoms. Thus, the surrounding region acquires this energy as heat that can be conducted out of the pile and used to drive a steam or gas turbine.

Primary problem now for the mathematically inclined is to develop a general theory of atomic-nuclei behavior, so that experimental data on nuclear phenomena will all fall within the theory's framework. When such a theory is established and published, it will be possible to carry out difficult experiments with ease and minimum wasted effort. First economical production of power from atomic energy may be five or ten years away—far enough to allow time to develop and test such a general theory.

At present only uranium and plutonium piles can operate continuously to produce power, but it seems that thorium, by a roundabout process, may be used as a primary fuel with uranium and plutonium. However, basic research on thorium has not been released, so it is still impossible to predict whether thorium fission can be used to advantage. From three to four times as much thorium exists in the earth's crust as uranium. It will be cheap.

ENGINEER'S APPROACH

While the materials and techniques of present piles are workable, they are generally too costly and often still highly inefficient. Improving design and construction is a long job, one that should be started as soon as possible with a highly coordinated staff.

The War Department is carrying out part of this work: $2,500,000 has been authorized for design and construction of the Daniels pile, world's first high-temperature pile. This project is reported to be primarily a means of testing certain ideas of general pile behavior at high temperatures. Oak Ridge engineers believe the Daniels pile will produce power in 1948.

A distinction between two types of piles can be made on the basis of the report of the Board of Consultants for the Secretary of State's Committee on Atomic Energy. Composed mainly of administrative scientists and engineers, this committee carefully distinguished "safe" from "unsafe" atomic-energy activities. "Safe" meant that plants, materials and methods could not easily be converted to military advantage except by adding large-scale facilities easily detected by superficial inspection. The primary piles, however, could manufacture plutonium suitable for bombs on very short notice, and perhaps secretly, by withholding a part of the production, and would therefore be deemed "unsafe." (For a long summary of this "Lilienthal" report, see POWER, June 1946, p 99.)

On the other hand, a high-energy reactor using denatured plutonium as a fuel was considered a safe activity that could be allowed countries and industrial concerns with only routine supervision and inspection. This plant would be "secondary" because it cannot operate without plutonium from primary plants.

Design engineers not connected with

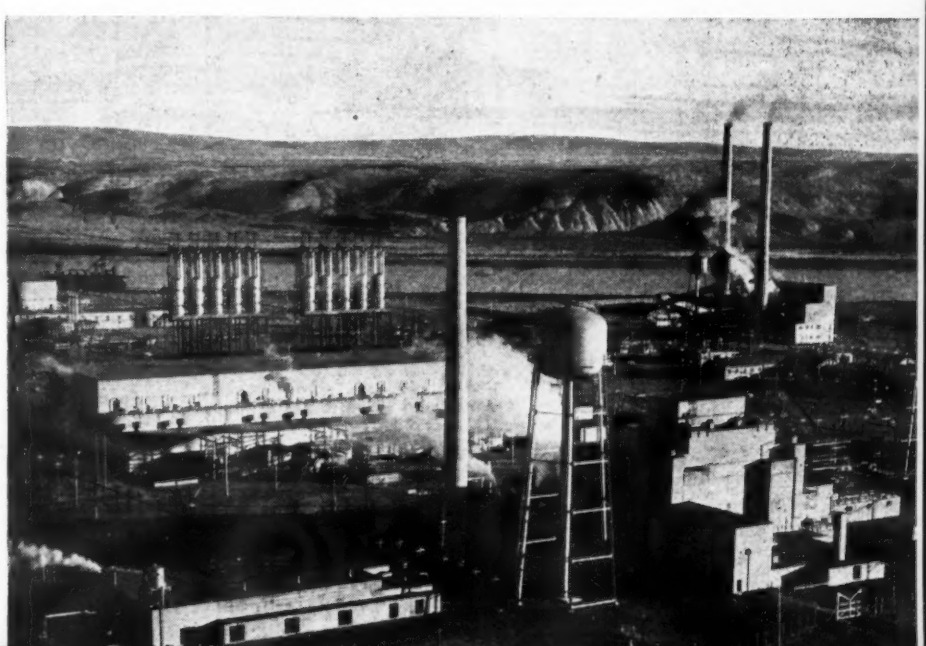


Fig. 2—One of the large units for plutonium production in Manhattan District plant near Richland, Wash. This and Fig. 3 are not part of report here presented in condensed form

the Manhattan District have studied available published information and tried to estimate roughly the cost of installing these high-energy reactors as the thermal units in power plants of two specified sizes, namely, 100,000 and 20,000 kw.

The 100,000-kw plant was seen as a thick shell of concrete and special radiation-insulating materials, perhaps 30 to 60 ft dia, sunk in the ground. Inside this shell would be a "tamper" or neutron reflector—perhaps beryllium or some other material that slows down neutrons without capturing them. Next to the reflector, possibly, would be placed a layer of chemicals so chosen that they would react with stray neutrons to form salable radioactive isotopes.

Inside this shell, the pile proper would be a mass of plutonium suitably protected from a highly purified moderator, such as carbon, intended to reduce velocity of the neutrons produced, and a heat-exchange medium of liquefied metal.

Preliminary calculations suggest that the means of transferring the heat from plutonium to steam will determine overall dimensions of the interior. The designer may circulate huge quantities of hot molten metal, or vaporize and condense a suitable metallic liquid. While both systems offer many difficulties, scientists familiar with present piles, are confident these difficulties can be resolved in a few years. In addition, machinery must be installed to load and unload plutonium, and perhaps occasionally to replace other parts of the pile unit.

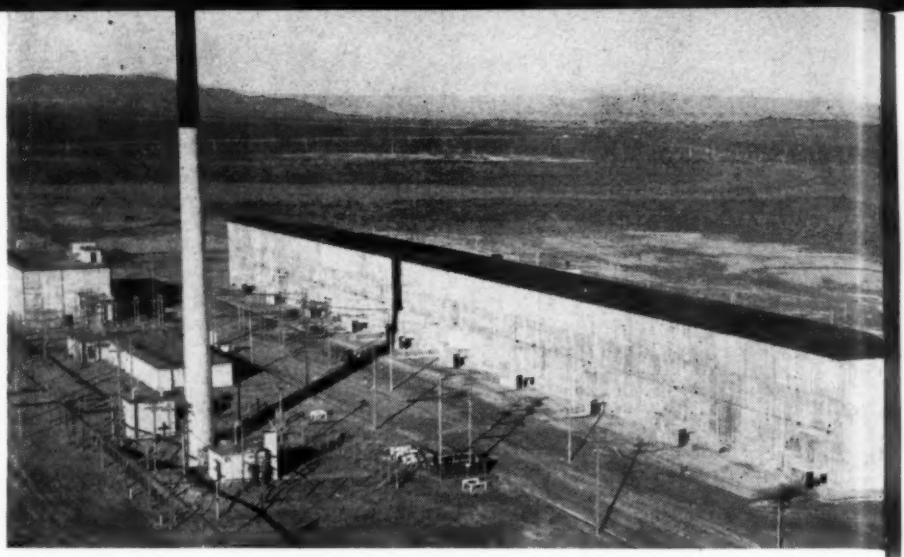


Fig. 3—A unit of equipment for plutonium production at Pasco, Washington. Publication of more specific information about the equipment is not permitted

A small chemical plant operated by remote control will be required to dissolve burned-out slugs and separate plutonium chemically from fission products. Unreacted plutonium can be returned to the pile. The radioactive fission products might be wasted to deep wells, similar to natural-gas wells, driven to a stratum where a suitable reservoir could be eroded out. Or these highly dangerous wastes might be led through a pipeline to the bottom of the ocean.

Any plant facilities installed to produce "tracers" (radioactive isotopes of various elements) would not be involved in power-production economics as the sale of tracers would pay for such facilities. Industry, medicine and scientific research can use these "tagged atoms" to trace flow of various fluids and compounds.

The prime mover (turbine) would be operated by steam or, perhaps, by air heated by coils containing the hot heat-exchange fluid from the pile. This indirect heating should keep out of the turbine the highly radioactive material that would prevent any repairs and maintenance. For high efficiency the turbine should operate above 1000 F.

Working without stack loss, such a plutonium-turbine plant should easily convert 40% of the heat involved into kilowatt-hours. The plant beyond the turbines—condensers, generators, transformers, etc—need not differ from conventional steam plants.

TABLE I—POWER STATION COST ANALYSIS

Assumptions:

1. Plant factor of 50 (4380 kwhr per year per kw installed capacity).
2. Utilization factor of 90 (peak load is 90 % of rated capacity).
3. Costs are representative for present designs in United States.
4. Designs of atomic-pile units essentially as described, *a preliminary estimate.*

Plant comparisons		*Coal*	*Coal*	*Primary pile*	*Plutonium reactor*	*Plutonium reactor*
Capacity, kw		20,000	100,000	500,000	20,000	100,000
Area, acres		2.0	10.0	10,000	2.0	2.0
Boiler room, ft²		400,000	1,500,000	2,000,000	200,000	600,000
Turbine room, ft²		200,000	900,000	3,500,000	200,000	900,000
Switch house, ft²		50,000	500,000	2,000,000	50,000	500,000
Thermal efficiency		25%	35%	40%	30%	40%
Employes		25	60	200	20	40
Capital Cost						
Land and improvements	$	60,000	600,000	2,000,000	60,000	100,000
Bldgs (exclusive of piles)	$	1,000,000	3,000,000	8,500,000	700,000	2,000,000
Pile units & accessory facilities	$	.....	.....	25,000,000	1,100,000	2,000,000
Fuel handling & storage	$	[	2,000,000	200,000	[	100,000
Condensing supply	$		250,000	1,500,000		250,000
Waste handling	$		100,000	1,000,000		100,000
Boiler plant	$	1,000,000	1,500,000	7,500,000	600,000	1,000,000
Draft system	$		200,000	.....		.....
Feedwater system	$		400,000	2,000,000		400,000
Piping system	$		500,000	2,500,000		500,000
Heat recovery apparatus	$	]	250,000	1,000,000	]	250,000
Turbine-generators & auxiliary equipment	$	670,000	2,400,000	10,000,000	670,000	2,400,000
Switchgear & wiring	$	250,000	1,200,000	6,000,000	250,000	1,200,000
Switching yard & equipment	$	300,000	800,000	2,500,000	300,000	800,000
Total	$	3,280,000	13,200,000	69,700,000	3,680,000	11,100,000
Per kw	$	164	132	139	184	111
Fuel (coal, $6 ton; U, $10 lb; Pu, $20 gram)	$	360,000	1,000,000	100,000	270,000	1,000,000
Wages and salaries (at $4000)	$	100,000	240,000	800,000	80,000	160,000
Maintenance & supplies	$	30,000	120,000	1,000,000	40,000	150,000
Fixed charges (15%)	$	490,000	1,980,000	10,400,000	570,000	1,660,000
Total cost per yr	$	980,000	3,340,000	12,300,000	960,000	2,970,000
Cost per kwhr		11 mills	7 1/2 mills	.....	.....	.....

This cost schedule is adapted from *Electrical World*, Dec. 2, 1939.

PRIMARY PILE

Primary-pile design is more involved than that just outlined for a high-energy plutonium reactor. In early designs the

primary-pile fuel would probably be an alloy of uranium and plutonium. Its principal process would involve fission of U-235 and plutonium, so carried out that neutrons released would create even more new fissionable material than is destroyed. In that case, plutonium and power are the principal marketable products, and pure, natural uranium, the only raw material required.

Economical operation demands a relatively large primary-pile unit because of the operating and chemical-processing equipment used, as well as the extraordinary facilities required for safe disposal of radioactive wastes. Building several small plants instead of one big one would multiply the most expensive facilities. Thus, primary-pile units must be expected to generate many hundreds of thousands of kilowatts when fully operated.

For every 8000 kwhr produced at 40% efficiency, one gram of plutonium could be separated.

The primary pile is a big enterprise deserving careful study in every detail. If the problem of transforming heat evolved into electrical energy is effectively solved for the primary pile, the same problem is solved for every plutonium reactor. In fact, practically every unit involved in the high-energy plutonium reactor is a special case of some larger, more complicated unit in the primary pile.

Best way to solve the engineering problem of atomic power is to organize a concerted effort to develop the new materials, techniques and components required for the primary-power pile.

INDUSTRIAL APPROACH

There is no reason to believe that fuel in a form purified for admission to the pile will cost more than $20 a lb for decades. If all or most of the uranium can be converted into either plutonium or power, initial uranium cost will be unimportant. Problems of mining and refining uranium will play only a minor part in the production of atomic power.

FISSION PRODUCTS

About one gram of assorted radioactive fission products will be produced for every 8000 kwhr generated with a thermal efficiency of 40%. To keep the plant operating effectively these fission products must be carefully separated from uranium and plutonium in chemical plants operated by remote control. Identity of the principal long-lived components of these fission products has been recently revealed, and they are slowly being made available to research laboratories. At present, only elements with "half lives" greater than one week can be considered useful and marketable tracers.

Of the many isotopes produced, only barium and iodine have any widespread industrial or medical use; the possible demand is too small to make even these a practical source of plant income.

Disposing of radioactive waste may largely determine location of many atomic-power plants. Desert or ocean-side sites appear to have distinct advantages.

Escaping neutrons that would ordinarily be absorbed in the shield surrounding the pile could be used in large part in nuclear reactions to produce synthetic radioactive tracer isotopes. For that reason a jacket was included in the suggested power-pile design to contain elements to be transformed into radioactive tracers.

Medical and experimental uses could account for only a minute fraction of the amounts potentially available. The chemical field could consume much larger amounts, and in increasing quantity. For example, demand in the chemical industry is likely to be great for carbon 14, a tracer isotope. An industrial value of about $500 per g can be given to C 14 as created by transmutation reactions in the jacket surrounding the secondary pile. Calculations indicate that a 100,000-kw pile station might produce from 100 to 1000 g of C 14 per year. In the long run, demand for by-product tracers may easily become large enough to warrant their production in most high-energy plutonium reactors.

ELECTRIC POWER

One unique feature of atomic power is that about half of it must come from primary plants in very large units to produce plutonium for "safe" secondary plants. Primary-plant cost is determined not so much by *size* of equipment as by *nature* of control mechanism required. A pile producing 200,000 kw would not cost much less than one producing 1,000,000 kw. Only the world's largest cities and industrial centers could accommodate sudden addition of 200,000 to 1,000,000 kw. Also, such regions usually have excellent transportation facilities, so conventional power fuel costs are moderate. In most such areas in the U. S., power rarely costs more to produce than 5 or 6 mills per kwhr.

Those nations having primary power-pile units will undoubtedly find it advisable to insist that they be very large units, both for political and economic reasons, and be located on isolated sites near large industrial areas.

PLUTONIUM

A 500,000-kw primary pile can be expected to produce about 550 lb plutonium per year. This would be suitably denatured and distributed for use in independently operated secondary piles at about $20 to $50 per g. Figures are obtained by analyzing conditions that must obtain before atomic-energy systems can compete with conventional fuels as an electric-power source.

COST FACTORS

Data not yet available for an economic study of atomic power include: (1) cost of primary power unit (2) cost of high-energy plutonium reactor (3) value of plutonium and (4) value of electric current produced.

In Table I cost breakdowns for 20,000- and 100,000-kw coal-fired central stations are from *Electrical World*, Dec 2, 1939. Since atomic-power plants differ principally in the thermal unit employed, many of the cost figures apply equally to them. The 500,000-kw atomic plant was chosen purely because it seems a reasonable compromise be-

TABLE II—EARNED INCOME

Plant comparisons	Primary-pile unit	Pu unit	Pu unit
Capacity	500,000 kw	20,000 kw	100,000 kw
Annual power produced	2,190,000,000 kwhr	87,600,000 kwhr	438,000,000 kwhr
Operating costs (fixed charges)	$ 12,200,000	$ 960,000	$ 2,970,000
Value of power/kwhr	4 mills	11 mills	7 1/2 mills
Income			
Sale of power	$8,800,000	965,000	3,290,000
Sale of plutonium	5,000,000 (250 kg)		
Sale of tracers	.....	50,000	250,000
Gross income	$ 13,800,000	1,015,000	3,540,000
Net income above estimated costs	$ 1,600,000	$ 55,000	$ 570,000

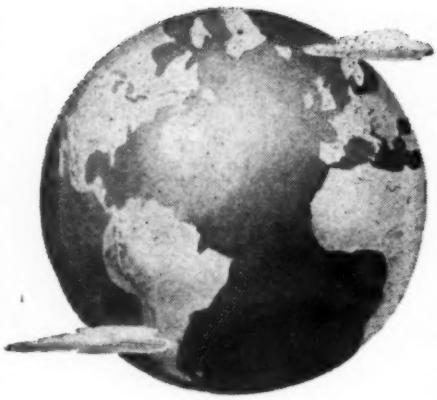
tween economy and practicability needs.

Actual cost of the thermal unit of an atomic-power plant, with requisite accessory facilities, is still largely guesswork. Conditions for entry of atomic units into the power-production field can be indicated if a price for power equal to that obtained from a typical coal-fueled power station of the same capacity is assumed.

On the basis of Table I, industrial power would cost 5 to 15% less than competitive units using coal at $6 per ton (13,000-Btu fuel) with plutonium at $20 per g. It will always be hard to apportion costs to plutonium and power, the two principal products of a primary pile. According to the American proposal, an Atomic Development Authority would operate such plants. The Authority would wholesale the power to nearby communities and auction off or otherwise distribute plutonium to smaller reactors in the vicinity. How much of the production cost can be assigned to electric current? The figure of 4 mills, Table II, represents a compromise between present urban industrial power costs and those obtained in the most efficient hydroelectric projects. This allowance yields plutonium, then, at a cost per Btu somewhat less than that of coal as an article of international commerce.

Actually, where both coal and plutonium compete as fuels for electric-power production, the deciding factor will be cost of the atomic unit that replaces fuel storage facilities and furnaces. Data in Table I permit estimating value of plutonium as a fuel and as function of the cost of the atomic unit.

Table III shows that the break-even point for the cost of 20,000-kw plutonium reactor is about $1,500,000, while for a 100,000-kw unit this point is about $6,000,000. Since actual cost of the 100,000-kw reactor would be less than double that of a 20,000-kw reactor, it seems likely that in regions of more or less constant fuel cost (seaboard areas



and along rail trunk lines) use of plutonium will lead to fewer but larger power installations. Most economical size station for power production is expected to jump from an average of 80,000 kw in 1939 to about 150,000 to 200,000 by 1960, if atomic energy is at all applied then.

COAL VS. PLUTONIUM

The large-sized unit's tendency to be more efficient is borne out by comparison of competitive values of coal and plutonium, assuming otherwise all data in Table I. Tables III and IV would be useful in making surveys of the applicability of atomic power to particular locations in North America and western Europe where market price of coal and other fuel is known, and where plant-cost adjustments can be estimated. However, in areas where interest rates are much higher, all tables must be reworked.

Tables I and II assume a yield of only 550 lb of plutonium from an original 10,000 lb of uranium. An approximately equal weight of fission products would be formed, so over-all efficiency of uranium use assumed is only about 11%, the remaining 89% going out with waste. The process need not be so inefficient, but even if it were, only 10 tons of pure uranium per year would supply 10% of the power used in the U. S. Production of 10 tons per year, or even 100, would not strain our resources for some time to come.

The chemical separating plants in primary piles may be actually fitted out to reprocess plutonium from nearby secondary piles, thus eliminating need for many small reprocessing plants that was assumed in the cost estimate. This presupposes ability to move highly radioactive material safely and cheaply, a situation that may be at hand. If small reactors are adapted to ships and submarines, it will be advantageous to have such equipment at all principal ports of the world.

Responsibility for construction and financing primary piles is very much beclouded. Since they can, almost on an instant's notice, be converted to manufacture of plutonium suitable for atomic bombs, manner of operation is of international concern. Who shall work out plans for primary-power installations and develop final design? Who shall operate the plants, etc? These questions must be answered to the satisfaction of all the world. Otherwise, atomic-power development can only mean preparation for destruction.

Because of its complications, its unknown factors and the international danger, the subject of primary piles deserves the concentrated attention of physical and social scientists, engineers and statesmen alike. The student of international relations will want to learn how plutonium may affect foreign trade. Public administrators will likely want to know the probable outcome of various power-distribution policies. Sociologists will like to discover effect of cheap electricity on retarded cultures.

The problems are many. The time, estimated at five to ten years, is just enough to make a fair start. If fears of atomic warfare can be allayed by prompt and intelligent action, atomic energy may become the first worldwide development to be approached rationally.

Table III—Plutonium Value Per Gram in Marginal Reactors

20,000-kw plutonium reactor		100,000-kw plutonium reactor	
Cost of pile & accessories	Pu value	Cost of pile & accessories	Pu value
$ 800,000	$27	$1,000,000	$34
1,100,000	24	2,000,000	31
1,500,000	20	4,000,000	25
2,000,000	14	6,000,000	19
2,500,000	8	9,000,000	8

Table IV—Plutonium and Coal as Competitive Fuels for Power Generation

20,000-kw station ($1,100,000 for pile & accessories)		100,000-kw station ($2,000,000 for pile & accessories)	
Coal price	Pu value	Coal price	Pu value
$ 3.00	$11	$ 3.00	$21
4.00	15	4.00	25
5.00	20	5.00	28
6.00	24	6.00	31
8.00	33	8.00	38
10.00	42	10.00	44
12.00	51	12.00	51

Replaces Lime With Caustic Soda for Dependable Water-Softener Operation

Eighteen months' experience using caustic soda, instead of lime in a hot-process water softener proves that the change-over not only lowers costs but improves softener operation

By T W HEISKELL
Chief Chemist
Pittsburgh Plate Glass Co

▶ THE PITTSBURGH PLATE GLASS CO purchased the chlorine and caustic-soda plant at Natrium, W. Va., which they operated during the war for Defense Plant Corp. As originally installed, feedwater makeup for the three 900-psi 180,000-lb-per-hr boilers was treated in a 40,000-gph hot-process softener.

A review of the lime-soda softening process after eight months' operation revealed unexpectedly high maintenance costs and frequent periods of interrupted treatment, both attributed to difficulty in handling milk of lime. An investigation based on raw-water analysis indicated that caustic soda could replace lime in the process with little increase in chemical cost. In addition, the caustic soda would provide a reagent that could be proportioned in solution rather than in suspension.

The changeover reduced operating costs, and makes the treated-water characteristics more consistent because: (1) pump failures are fewer (2) solution does not require as much agitation (3) feed lines do not plug (4) lime dust is eliminated (5) tank charging requires less time and effort (6) less chemical-storage space is needed (7) the proportioning-equipment adjustments are more dependable.

In the process of softening water by chemical precipitation, hydroxyl ions are required for precipitation of calcium bicarbonate and magnesium salts, and carbonate ions for precipitating noncarbonate calcium hardness.

Reactions representing one process may be written as follows:

1. $Ca(HCO_3)_2 + Ca(OH)_2 = 2\ CaCO_3 + 2\ H_2O$
2. $Mg(HCO_3)_2 + Ca(OH)_2 = 2\ CaCO_3 + Mg(OH)_2 + 2\ H_2O$
3. $MgSO_4 + Ca(OH)_2 = Mg(OH)_2 + CaSO_4$
4. $CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4$

The reactions may also be expressed as:

5. $Ca(HCO_3)_2 + 2\ NaOH = CaCO_3 + Na_2CO_3 + 2\ H_2O$
6. $Mg(HCO_3) + 4\ NaOH = Mg(OH)_2 + 2\ Na_2CO_3 + 2\ H_2O$
7. $MgSO_4 + 2\ NaOH = Mg(OH)_2 + Na_2SO_4$
8. $CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4$

Primary difference in the two methods is the fact that bicarbonates may be either completely precipitated with lime and the entire soda-ash requirement added, or they may be partly precipitated with sodium hydroxide to form sodium carbonate, thereby reducing the required soda-ash dose. Selecting either set of reactions as the more desirable depends on the analysis of the water to be softened. Roughly, where noncarbonate hardness is two or more times the carbonate hardness, caustic soda may be used advantageously.

This is seldom recognized in water-conditioning literature, first set of equations usually being published alone despite the fact that the lime must be used as a slurry. In this form it has a decided caking tendency unless constantly agitated. Operating difficulties and maintenance expense resulting from use of lime are not easily foretold and are often overlooked after operation begins. In this article the data, taken from work-order and cost-accounting records, compare operation with lime as against caustic soda.

Experience With Lime. For eight months Ohio River water was softened with lime and soda ash according to conventional softening equations 1 to 4. Chemicals were charged into separate 1200 gal tanks and proportioned by an electric timer-controlled motor that lowered internal swing pipes into the solutions. Each tank had two centrifugal pumps (main and spare) to feed the solution into the sedimentation tank. Full charge was 0.92 lb of lime and 1.1 lb of soda ash per gal.

It soon became evident that equipment handling lime required excessive maintenance to correct such mechanical difficulties as: (1) leaking pump packing (2) pipes plugged with lime (3)

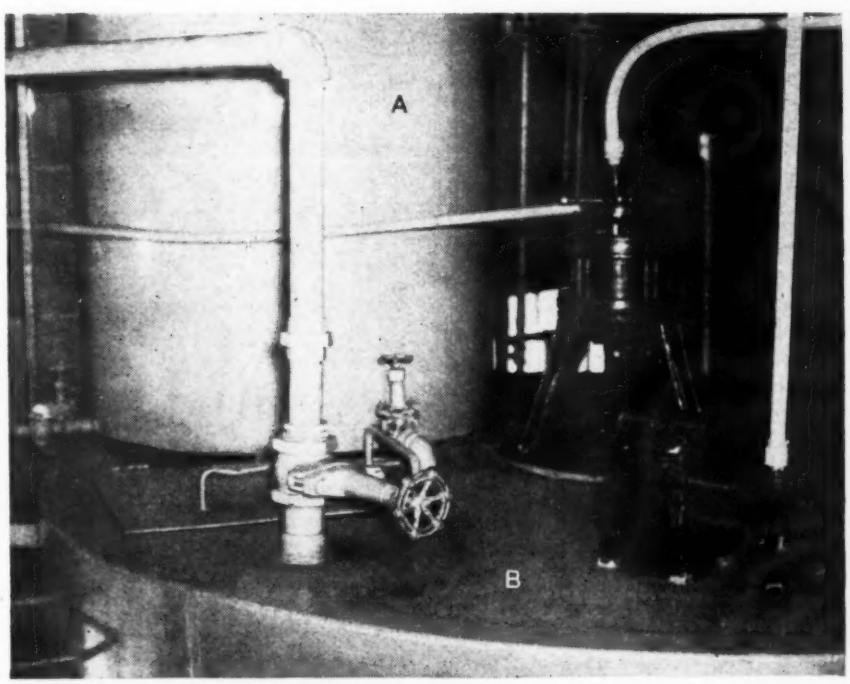


Fig. 1—Measuring tank A, filled by pump from main storage, mounts conveniently atop mixing tank B, into which the concentrated caustic flows by gravity

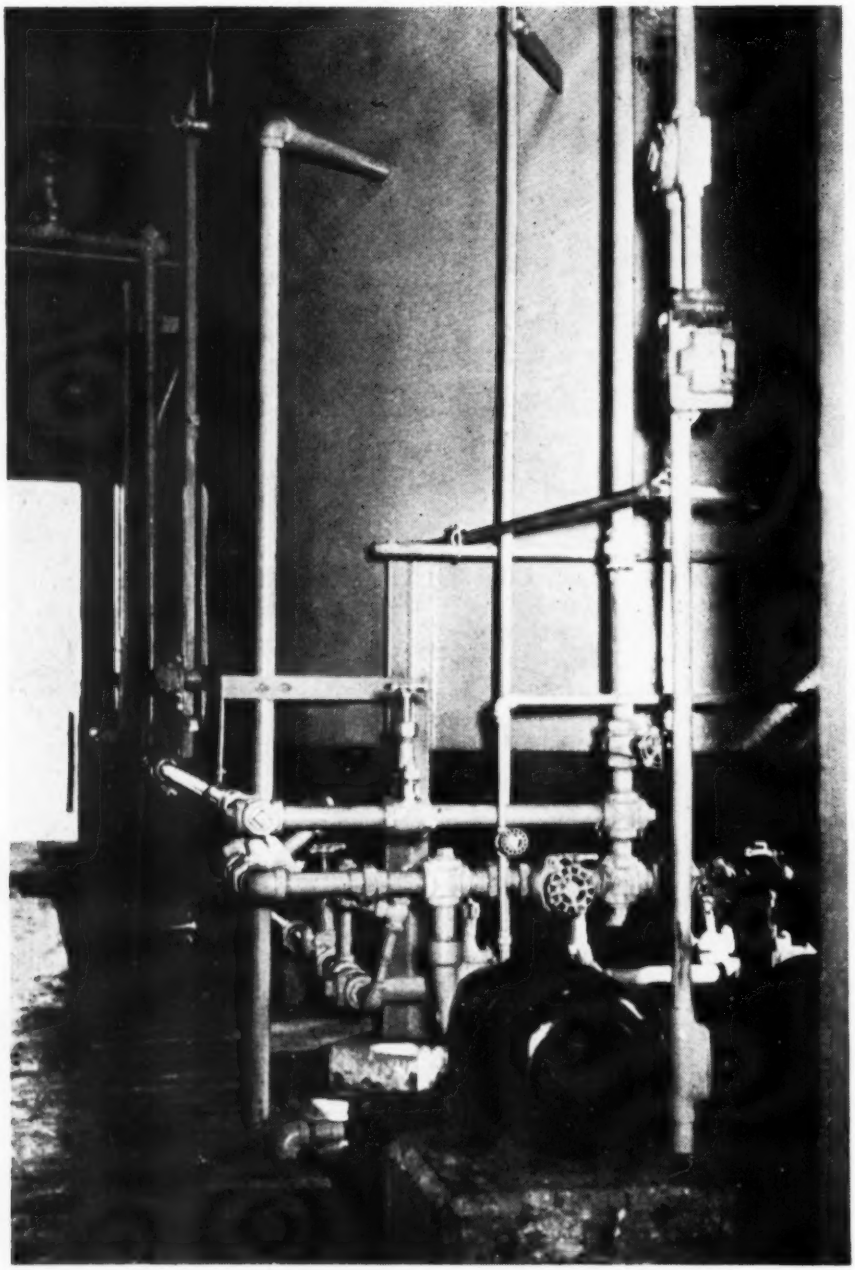


Fig. 2—Besides the advantage of more uniform water treatment, the change to caustic soda eliminates lime dust, which created a serious housekeeping problem

lime-tank agitator shaft broken (4) weir box in lime tank plugged (5) lime agitator broken (6) lime caked in mixing tank (7) scale on lime-pump impellers (8) failure of lime-agitator bearing. Costs, per 1000 gal water treated were: chemicals, $0.0166; labor and materials to maintain lime-feed equipment, $0.150.

Other Lime Disadvantages. In addition to this high total cost, other disadvantages resulted: Every mechanical failure interrupted water treatment. Lime dust interfered with operation of proportioning instruments, caused discomfort to operators, and created a definite housekeeping problem. Lime, which caked in the weir box and swing-pipe joints and thus prevented flow to pumps, caused frequent chemical-feed interruptions. The pipe from lime pumps to sedimentation tank and recirculation orifice plugged repeatedly. Fortunately, the softener operated at 30 psi and thus line and orifice could be blown out. Otherwise, drilling or acid cleaning would have been necessary. Vertical lime agitator was checked often for alignment, but continuous service in the lime slurry caused the shaft to whip—a fault which could not be entirely removed but which made frequent repairs constantly necessary.

Under these conditions it was impossible at times to maintain correct chemical proportions. For 17% of the time that lime was used, treated water contained only carbonate and bicarbonate alkalinity because the proper amount of lime could not be added. Treated-water hardness at these times ranged from 0.8 to 1.1 gpg.

Caustic Soda. To replace the lime, 50% caustic-soda liquor, containing no sodium hypochlorite and less than 0.0006% sodium chlorate, was selected because chlorates and hypochlorites are somewhat corrosive to iron. The liquor is stored in an unlined cylindrical steel tank inside the building. A small centrifugal pump transfers it to a 3x4-ft steel measuring tank fitted with a sight glass and mounted on top of the former lime-mixing tank, Fig. 1. The latter is charged by opening a valve in bottom of measuring tank. With this arrangement the mixing tank can be charged so rapidly that a metering impulse of the chemical proportioner is seldom missed and steady treatment results. Measuring tank can be charged at the operator's convenience by simply starting the pump, Fig. 3.

CONTENT ANALYSES

Analyses were made on 82 different 50% solutions received to determine the amount required for a charge. These varied less than 0.6% NaOH, and diluted solutions in the mixing tank were so constant that no adjustment of the proportioner was required. Therefore, analyses for caustic strength were discontinued. Five minutes' agitation after a tank charge is sufficient to mix the solution. This reduces agitator maintenance and permits both soda ash and caustic weir boxes to set on a smooth liquid surface with no splashing to interfere with amount of solution withdrawn.

Of interest is the ease with which chemical addition can be controlled to hold desired excesses of sodium hydroxide and sodium carbonate. As long as hardness requirements are met, and it is only necessary to adjust the excess, feed of either caustic soda or soda ash can be adjusted independently. This, of course, was not possible when it was necessary to increase both lime and soda ash, according to their relative mix-tank concentrations, to obtain more sodium hydroxide.

Caustic liquor greatly reduces manual labor, and elimination of lime dust improves appearance of softener building and equipment. Fig. 1 and 2. No embrittlement or other metal corrosion

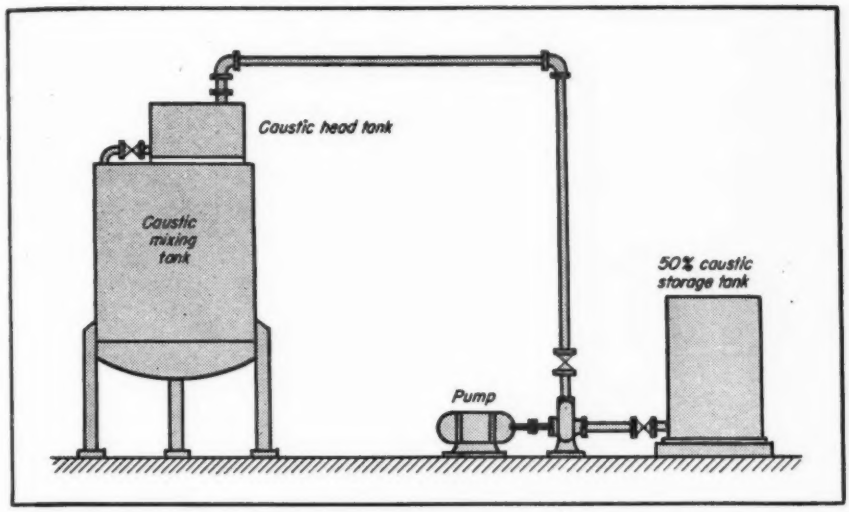


Fig. 3—By simply starting the pump, measuring tank can be filled at operators' convenience. Changeover to caustic soda releases them for other timely duties

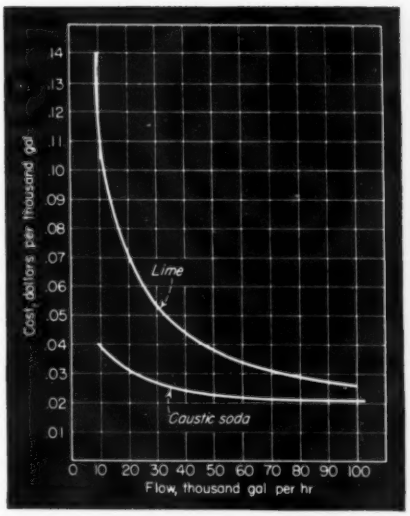


Fig. 4—Low-priced chemicals may be economical if water volume is large

due to caustic soda has been found except on one small brass valve that was replaced with steel.

According to theoretical chemical equations, lime precipitates twice as much calcium-carbonate sludge as does caustic soda. Accordingly, sludge blowdown from the softener was reduced from once in eight hours to once in 16. This results in negligible cost saving, estimated at $75.00 per year, but saves time which, added to that gained by steadier softener operation and faster tank charging, permits operators to assume duties such as flue-gas analyses, preparation of coal samples and service water chlorination. During the entire first year of caustic-soda operation, poor treatment caused by equipment troubles occurred only five times, or 1.4% of the time—an appreciable reduction.

Chemical Costs. In preparing a comparison of chemical costs, theoretical values are not used because of some uncertainty about the amount of calcium carbonate decomposed by heat in the softener and the possibility that magnesium may precipitate as a basic carbonate or hydrated hydroxycarbonate, instead of true hydroxide. Instead, actual amounts of chemicals used, Table 1, were recorded daily for this purpose. Investment costs are not included.

Maintenance Labor Costs. These include time of mechanics, repairmen and helpers, but do not include time that operators or supervisory personnel spent cleaning pipelines or maintaining equipment.

	With lime	*With caustic*
Total man-hours	5856	1389
Total labor cost	$5558	$1558

Since pumps and other equipment were used continuously, regardless of amount of water treated, their maintenance cost is more nearly a function of hours of service than of gal of water softened. Therefore, to compare treatment costs per 1000 gal it is necessary to assume that for each set of cost figures amount of water treated is the same. For this reason total raw-water flow of 47,566,800 gal between July 1, 1943 and March 1, 1944, is used with both lime and caustic-soda figures to obtain the following costs. Basis, 1000 gal raw water:

	Lime treatment	*Caustic-soda treatment*
Chemicals	$0.0166	$0.0235
Maintenance material	0.0121	0.0037
Maintenance labor	0.1379	0.0328
Total	$0.1666	$0.0600

(Continued on page 164)

Table I—Costs of Chemicals

(a) These figures show the cost of lime-soda softening per 1000 gal of raw water treated. They are based on the month of Feb. 1944 and represent prevailing conditions.

Total amount of lime	3,865 lb
Total amount of soda ash	14,973 lb
Raw water treated	10,387,800 gal
Basis: 1000 gal raw water	
Lime 0.372 lb at $12.00 per ton	$0.0022
Soda ash 1.441 lb at $20.00 per ton	0.0144
Total	$0.0166

(b) These figures show cost of softening with caustic soda and soda ash per 1000 gal of raw water treated. They are based on the same number of days in March 1944 when raw-water hardness was the same as for Feb.

Total amount of 50% caustic soda	4,350 lb
Total amount of soda ash	3,905 lb
Raw water treated	4,984,200 gal
Basis: 1000 gal raw water	
Caustic soda 0.872 lb at $36.00 per ton	$0.0157
Soda ash 0.783 lb at $20.00 per ton	0.0078
Total	$0.0235

Table II—Costs of Maintenance Materials

Equipment	Lime 7/1/43-3/1/44	Caustic soda 3/1/44-3/1/45
Pumps:		
No. 1 lime (caustic)	$47.76	$7.92
No. 2 lime (caustic)	53.08	10.45
Motors:		
No. 1 soda ash	8.38	0.00
No. 2 soda ash	1.04	3.95
No. 1 lime	4.91	0.00
No. 2 lime	7.92	35.55
Soda-ash agitator	35.20	4.18
Lime agitator	3.80	43.25
Tanks and feed lines:		
Lime to sedimentation tank	224.08	38.69
Lime-mix tank	38.34	7.16
Soda-ash mix	40.34	9.82
Miscellaneous:		
Lime agitator	108.73	7.18
Soda-ash agitator	3.80	8.25
	$577.38	$176.41

LEE of CONSHOHOCKEN

Modernizes Plant and Power

In revamping and extending plant productivity, this manufacturer of tires builds a modern pulverized-coal-fired power plant, featuring mechanized coal-handling and ash removal

▶ UNTIL RECENTLY a battery of five 10,000-lb-per-hr low-head boilers was the only means of supplying steam to processes of Lee Rubber & Tire Corp's plant at Conshohocken, Pa. Like many other war-loaded rubber manufacturers, Lee had pushed all its equipment with scarcely a letup for several years.

But new processes already at hand, coupled with improvements in older production methods, led to a heavy building program at Conshohocken. One unit, a modern steam-generation plant, was designed and is now supervised by H H Rice, master mechanic, and Frederick Leopold, chief engineer.

Modern Power Plant. This plant houses two new 40,000-lb-per-hr 480-psi 700-F steam generators, firing pulverized coal of about 80% fineness through 200 mesh. At present, steam generated at 135-psi, saturated, mixes in the steam main with output from the old low-head boilers. An office-type intercommunication system regulates loading and handling of old and new units, operating in separate plants. As soon as personnel are fully grounded in operating the new units, this interconnection will stop.

Eventually all steam at 480 psi, 700 F, will feed into a main from which a proposed 1875-kva 100-psi backpressure turbine and reduction valve (480 to 100 psi) will draw steam for electric generation and process. This latter load includes steam-driven hydraulic pumps that develop, for various needs, four pressure levels at 175, 500, 1200 and 1900 psi with separate piping.

Front view of new power plant shows rails for incoming coal cars, bucket elevator for loading and 750-ton silo combining live and dead coal storage

Plans call for a desuperheater to receive exhaust from the proposed turbine at 100 psi, 455 F, and to reduce a maximum of 70,000 lb per hr to steam at 100 psi, 350 F, again for certain process needs throughout the plant.

Makeup and Returns. Condensate and process returns amount to about 15 to 20%. These join in a 100,000-gal-per-24-hr deaerator with makeup water pumped from a 500,000 gal concrete reservoir through two zeolite softeners, each with capacity of 80,000 gal per 24 hr. The reservoir receives raw water from three 500-gpm deepwell pumps to meet an 800-gpm demand for direct process needs and makeup.

Coal and Ash Handling. Here the use of mechanized systems is featured in the new equipment. Arriving by rail, coal may be dumped from cars direct to storage or fed by conveyor belt to a primary crusher. This crusher handles a maximum of 30 tons per hr of dry coal, and dumps it by gravity feed to a bucket elevator. The elevator raises it to a screw conveyor at top of a 750-ton glazed-tile silo whose floor is concrete.

Coal Silo. The structure is divided into two sections for live and dead storage. Upper or live-storage portion holds 250 tons. It receives incoming coal and, when full, drops the overflow into the lower or dead-storage section, which holds 450 tons. Both sections have gravity drains spotted along their floors for moisture drainage.

When coal is needed from dead storage, it passes through a chute to the bucket elevator where it is redirected to live storage. From this level a chute routes it to an electric weigh larry, which conveys it to individual furnace pulverizers. A cross-connection between pulverizers and boilers enables coal from a given pulverizer to be fired in either furnace.

Combustion of this pulverized coal occurs within a waterwalled furnace with flat watercooled floor. Before entering a tubular air heater, gaseous combustion products pass (1) through slag screen (2) through superheater located so as to pick up both radiant and convection heat (3) into and through connecting tube banks between steam-release drum and mud drum. Baffling throughout the boiler is designed to direct gas passage in a crossflow direction to the tube sections for higher heat.

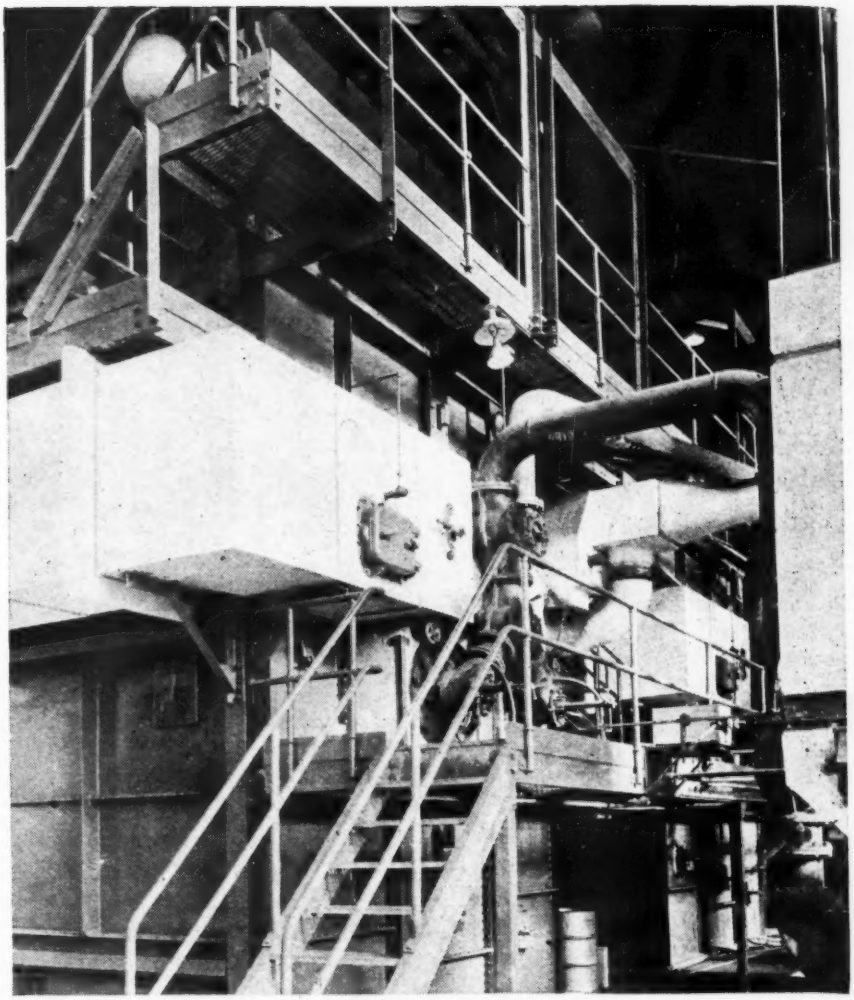
Dust Collector. After gas has passed through the tubular air heater and before it reaches the induced-draft fan, it enters a tubular dust collector. This collector removes entrained flyash and dust by centrifugal force. An inlet plenum chamber directs gas toward a series of steel tubes, each consisting of inner and outer tube. The outer tube with external directional vanes on two inlet slots receives incoming gas and directs it tangentially around its inner surface. Heavy dust particles drop out of the gas stream. This tube connects with a dust-collecting hopper. Second or inner tube extends below the inlet slots and provides the outlet port for dust-free gas to continue through the hopper and eventually to the stack.

VACUUM ASH REMOVAL

Removal of flyash, furnace ash, preheater siftings and dust depends upon a vacuum system comprising 8 in. ash-conveyor lines, steam vacuum producer, ash receiver-and-separator, air washer with filtered vent, and ash-collection silo and unloader equipment.

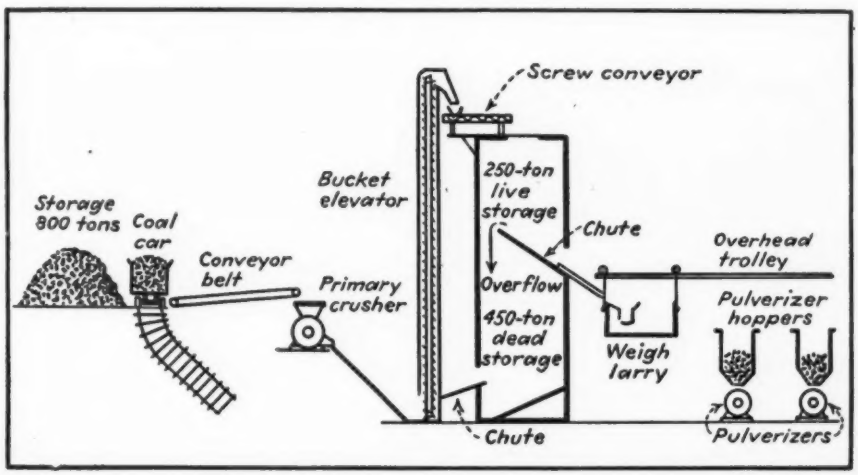
Furnace ash, pushed from the hearth by an air jet into an ashpit, enters this ash-removal system in either of two ways: (1) *Takeoff line.* This entry for the bulk of the ashes opens on the inclined floor of the furnace ashpit from the right sidewall. Conshohocken practice helps the ash feed into this 8-in. suction line by using an ash hoe applied from the ashpit door on opposite side of furnace. (2) *Grid-hopper assemblies.* Any pieces, too large and hard to be broken up and drawn into the takeoff line by the vacuum, are hoed out and deposited on a grid of 1½-in.-square steel bars welded into 4-in. mesh for final breakup. Pieces able to pass through this grid drop into a hopper assembly before entering the ash-convevor lines. A grid-hopper assembly is located at the ashpit door on both sides of each furnace.

These grid assemblies connect to conveyor lines through fittings designed so ash comes in at an angle that permits air to intermingle with it in proportions that reduce tendency to clogging. But should the ash clog and additional air be needed, an automatic air-intake valve opens at the conveyor-line end just beyond the intake hopper. In its normally closed position a counter-weight on a pivoted valve arm holds the valve in position.

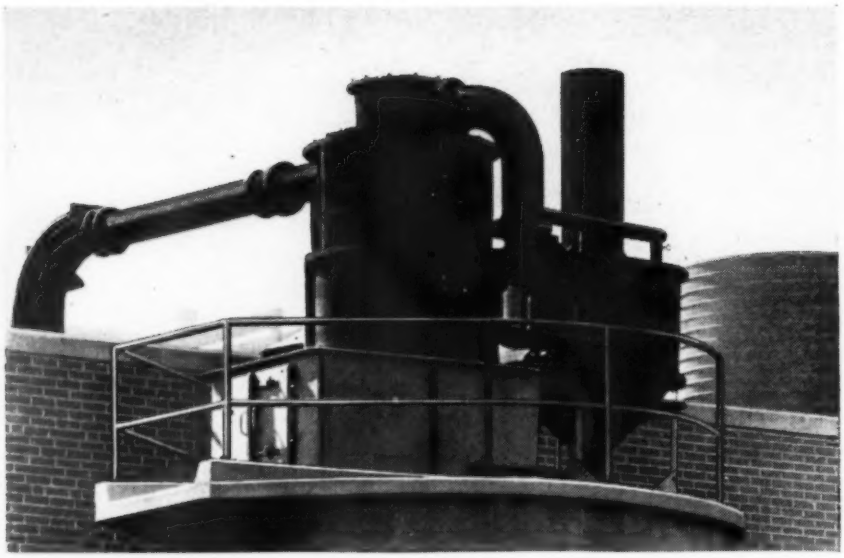


Cross-connection (black piping) between pulverizers appears above burner inlets in the firing-aisle view. Air duct and pulverizer piping also show prominently

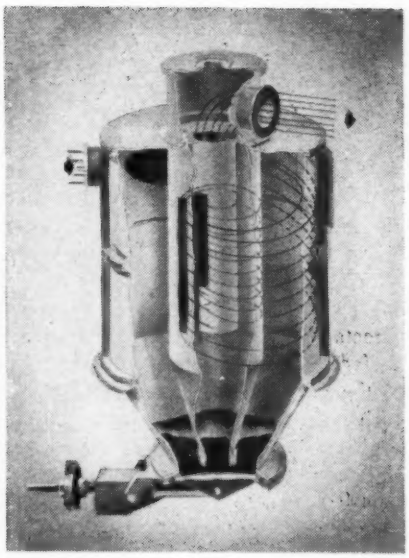
Siftings, Dust, Flyash. At both sides of the rear of each furnace, a set of takeoffs form two inlets to the system—one drawing from the rear boiler pass, the other removing siftings from the air preheater. Through a Y fitting they join as a common supply to the branch conveyor line serving the individual boilers. These branches, in turn, connect with the main 8-in. conveyor line. Material removed by the dust collector is drawn into the main line through a



Diagrammatic view of the coal handling shows travel of incoming coal to pulverizers from storage by conveyor belt, primary crusher and elevator



Typical ash system with reinforced riser, left; ash receiver, storage silo, top at center; exit line and steam nozzle, right, leading to air washer and vent



Ash receiver cutaway depicts arc travelled by airborne ash in cylinders

hopper and feed line that ties this collector into the system. In addition a 6-in. line from bottom of the chimney withdraws all settled flyash into main removal system.

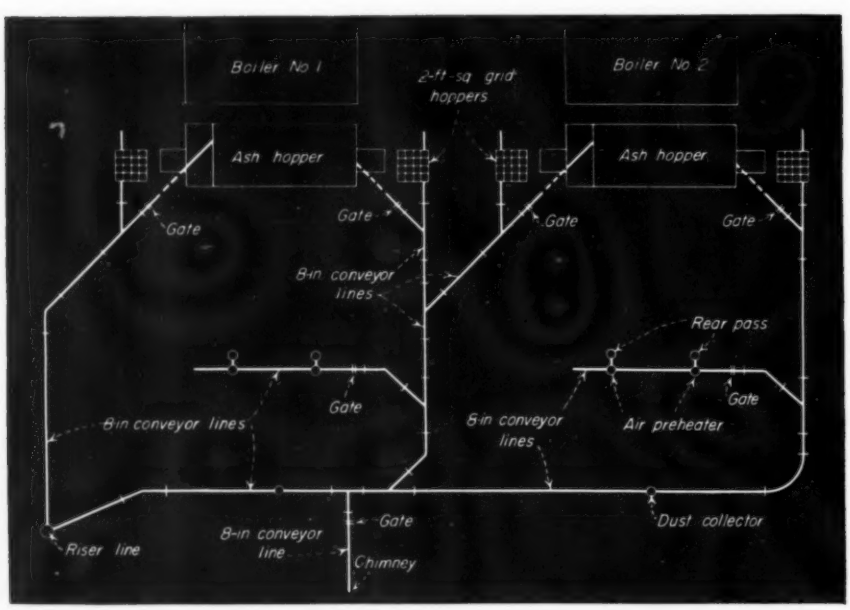
All material—ash, siftings and dust, with the air streams carrying them—passes through a riser, about 47 ft, 8 in. high, into an ash receiver-and-separator. This unit consists of three cylinders about a common center. Outermost cylinder, of ¾-in. metal casting, has ID of 4 ft, with removal impingement plate 4 in. thick. Second cylinder's ID is 2 ft, and third's is 10 in.; both are of ¼-in. steel. Top and conical bottom of receiver and separator are ¼-in. steel plate.

Ash Separation. Ash and air enter top of this receiver-and-separator from the 8-in. riser line at a tangent. Centrifugal force throws out heavier ash material in the course of its 270-deg arc within the first cylinder. Removal impingement plate in this area of greatest attrition helps extend this cylinder's working life.

At end of the 270-deg arc a slotted port admits remaining ash and air into second cylinder. All entrained dust and fine ash, still present after a 270-deg travel through this cylinder, enter a slotted port opening into the last cylinder. Whatever airborne particles remain after travel through this cylinder, exit through an 8-in. line from top housing.

Into this 8-in. exit line a steam exhauster with multi-jet nozzle feeds 135-psi saturated steam at the rate of 200 lb per hr per ton ash to produce a vacuum, at riser connection of the main conveyor, of over 4 in. of mercury with main line closed, and of about 2 in. with it open. Flow in this line, now fine ash, dust, air and steam, discharges tangentially into a 4-ft-ID cylinder of ¾-in. cast metal used as an air washer.

Steam Jet Exhaust. At top of air washer an 18-in.-ID vent, 4 ft high, exhausts to atmosphere. Within the washer four water-spray nozzles, one in each of the four quadrants, condense and clean exhaust steam before it is vented to atmosphere. Bottom is a ¼-in. conical steel plate into which a 4-in. drain connects. Drainage from the air washer discharges into a sump in which foreign waterborne particles settle out before this water enters a sewer.



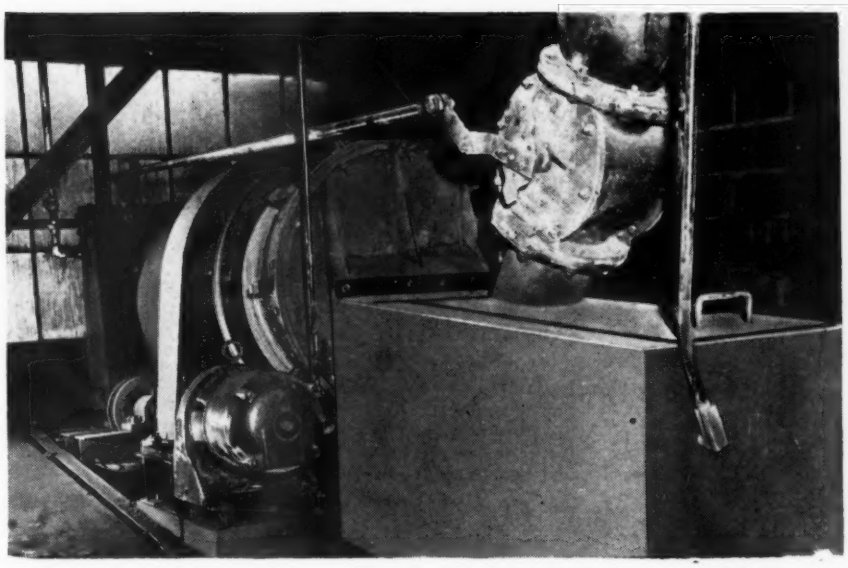
Layout of conveyor lines removing ash from furnace hoppers, siftings from preheaters, dust from dust collectors and flyash from chimney to a common riser

ASH DISPOSAL

Elements of the ash-removal system described above mount on top of a 35-ton glazed-tile 12-ft-ID silo for ash storage. Particles of varying size dump into the silo from the ash receiver-and-separator, thus: Heavier particles that were separated in the unit's first cylinder fall to bottom of conical hopper connected to this receiver. Within this

main hopper a second conical hopper handles discharge from the two inner receiver cylinders. This 2-hopper method seals off the second and third cylinders from ash separated in the first cylinder, preventing any separated material from being drawn back into the air stream on its way to the exit top housing.

Both conical hoppers direct all ash to the top of a circular 24-in.-dia rubber-gasketed steel gate held in place by the vacuum within the receiver during operation of ash-removal system. A counterweight, mounted on an arm connected to this discharge gate, overcomes weight of the gate to hold it in closed position if the hoppers are empty. If ash has collected on the gate and the vacuum is removed (which occurs just after operation) collected-ash weight is sufficient to open the gate. The ash then dumps into a storage silo.



Sealed unloader receives ash from storage silo through rotary gate onto vibrating feeder before dumping into a rotating drum to wet down for removal by truck

REMOVING STORED ASHES

When unloading this silo, ash flows from its hopper into an inclined feed. through a rotary gate fitted with a revolving scraper to prevent hang-up, onto an electric vibrator within the sealed unloader. During unloading the silo vents through a 3-bag filter house on top of the silo.

Unloading Control. Ash unloads from the silo at a rate controlled by a rheostat connected in the magnetic circuit of a 60-cycle 440-v ¼-hp vibrating motor. Ac applied to this motor's field produces an oscillating action on the armature which vibrates a set of bars, fixed at the ends but free to flex or vibrate at the center. A clamp at the center of these vibrating bars rocks the feeder deck up to a maximum of 7200 strokes per min, and enables loading up to 25 tons per hr. Ash moves across this deck in a series of rapid hops although it appears to flow smoothly. The hopping action keeps ash largely in suspension and reduces any sliding contact between ash and deck so the latter does not suffer heavy abrasive wear.

To control ash-feed rate across this deck, time of each vibrating stroke is varied by increasing the pull or hold of the magnetic circuit, thus regulating the number of strokes over a unit of time.

Final Dumping. Ash drops off the end of this vibrating deck into a 2½-ft-IDx6 ft sloped revolving drum of 1-in. metal casting. A 3-in.-dia steel pipe extends the inside length of the drum and discharges water through one cone and two flat spray nozzles at city pressure to wet down the ash to desired consistency. This wetted ash moves forward through the drum to fall off through a discharge end box into a truck. An adjustable scraper under action of tension springs and supported from this water-pipe header prevents build-up of heavy ash accumulation on the drum.

PRINCIPAL NEW POWER-PLANT EQUIPMENT

Plant of Lee Rubber & Tire Corp at Conshohocken, Pa.

GENERATING EQUIPMENT:

Turbine-generator, 1, noncondensing, 100-psi backpressure.....Proposed
1875 kva, 3600 rpm, 480 v, 3 phases, 60 cycles
Motor-generator, 1.....Westinghouse Electric Corp
400 kw, 1200 rpm, synchronous

BOILERS AND AUXILIARY EQUIPMENT:

Boilers, 2.....Riley Stoker Corp
2 drums, 40,000 lb per hr, 480 psi, 700-F steam, each
Superheaters, 2.....Riley Stoker Corp
Preheaters, 2, tubular.....Riley Stoker Corp
Desuperheater, 1.....Elliott Co
70,000 lb per hr, 100-psi steam from 455 down to 350 F
Deaerator, 1, 100,000 gal per 24 hr.....Permutit Co
Feedwater regulators, 2, Copes Flowmatic.....Northern Equipment Co
Water columns, 2, Eye-Hye attachment.....Reliance Gauge Column Co

COMBUSTION EQUIPMENT:

Pulverizers, 2, 600 lb per hr, 80% fineness.....Riley Stoker Corp
1, motor driven; 1, motor or turbine driven
Soot blowers, 8, 4 per boiler, steam.....Diamond Power Specialty Corp
Induced-draft fans, 2.....Clarage Fan Co
83,000 lb gas per hr, 1 per boiler; steam or motor driven
Forced-draft fans, 2.....Clarage Fan Co
75,000 lb air per hr, 1 per boiler; steam or motor driven
Fan and pulverizer drive, electric.....Allis-Chalmers Mfg Co
Fan and pulverizer drive, steam.....Moore Steam Turbine Div, Worthington
Combustion control.....Brooke Engineering Co
Stack, steel, 105 ft high, 7.75 ft dia.....Philadelphia Stack Co

METERS AND INSTRUMENTS:

Flowmeters, steam and water.....Ring-Balance Instrument Co
CO_2 meters, indicating and recording.....Permutit Co
Gages, draft.....Ellison Draft Gage Co
Gages, steam.....J E Lonergan Co
Meters, recording.....Bristol Co

COAL AND ASH HANDLING:

Coal-handling equipment.....Link-Belt Co
Coal-storage silo.....Link-Belt Co
Ash-handling equipment.....Beaumont-Birch Co
Dust collectors, 2.....Prat-Daniel Corp

PUMPS, PIPING AND VALVES:

Deepwell pumps, 2, 500 gpm, 200-ft lift.....Deming Co
Boiler feed pump, 1, electric, 200 gpm, 530 psi.....Ingersoll-Rand Co
Boiler feed pump, 1, steam, 200 gpm, 530 psi.....Westinghouse Elec Corp
Piping.....Daniel J Keating, contractor
Valves.....Edward Valves, Inc

A REPORT ON ASME FALL MEETING

Highlights of the fuel session were oil firing and self-contained boilers, while hydro utilities and turbine-deposit removal were of paramount interest at other discussions

D Robert Yarnall, president of ASME, who spoke at the Boston meeting's opening luncheon on engineers' traits

▶ FOR THE FIRST TIME in 18 years the American Society of Mechanical Engineers held its annual fall meeting at Boston, Mass., from Sept 30 to Oct 3, inclusive. The New England section, host for the 4-day gathering, presented papers of national interest.

Chairman H M King, General Electric Co, introduced the opening-day speakers: (1) Maurice J Tobin, governor of Massachusetts (2) D Robert Yarnall, president of Yarnall-Waring Co and president of ASME (3) F S Blackall, Jr, president and treasurer of Taft-Peirce Mfg Co.

Governor Tobin welcomed the delegates to Boston, and congratulated them on their wartime achievements in converting the advances of science into finished, usable goods.

President Yarnall mentioned briefly the successful meetings at Chattanooga and Detroit, and then outlined the beliefs, training, social thinking and other traits that characterize the engineer.

F S Blackall, Jr, who delivered the principal address, expressed the opinion that, in the last decade or two, engineering fields—statistical methods of quality control, electronics (handmaid of both electrical and mechanical engineering) and nuclear fission, to name a few—have so broadened that ASME should extend membership requirements also, to assure its standing as a society of leading engineers.

The main banquet featured the conferring of honorary membership upon Ralph E Flanders, president, Jones and Lamson Machine Co, a recognized authority on machine tools, and Irving E Moultrop, now retired from Edison Electric Co of Boston, a pioneer in high-pressure, high-temperature steam.

Principal speaker at this banquet was A C Klein, engineering manager of Stone & Webster Engineering Corp, who spoke on the military and industrial future of atomic energy. He stressed the fact that figures released by the government on the combined costs of engineering, construction and research show 90% went for construction and engineering, 10% for research. Such a balance, he feels, indicates the role of the engineer in any future program, military or industrial.

Fuel Oil. At the first of two fuel sessions, R J Bender, assistant to chief consulting engineer, Sinclair Refining Co, discussed *Twenty Years of Progress in Industrial Oil Firing.*

Bender directs credit to the Naval Boiler and Turbine Laboratory at the Philadelphia Navy Yards for development leading to troublefree use of heavy fuel oil aboard combatant ships. These contributions cover (1) rules of thumb to prevent storing incompatible oils together—a practice that produces precipitation of heavy components and formation of sludge (2) heater and oxidation tests designed to indicate stability and fouling tendencies of fuels under simulated operating conditions (3) study of ash components contained in fuel oil as fired and their action upon boiler elements.

After this acknowledgment to the Navy, Bender described three classes of oil burners: steam atomizing, mechanical atomizing and rotary-cup burner, with emphasis on the restrictions and limitations of each. Chief point centered on the proper relation between fuel and air over a range of capacity with latest mechanical atomizing units now developed to cover a scope of 20 to 1 in unit capacity.

Self-contained Boilers. At this same fuel session, Martin Frisch, director of engineering and development of Foster Wheeler Corp, and H H Hemenway, an

assistant of Frisch, had as their subject, *The Packaged Boiler*. The paper covered the company's experience and designs in meeting, first, a 1940 need for watertube portable steam generators in the oil fields and, second, the group of demands arising during the war for standardized plants for (1) power loads of war-torn areas (2) heating load of diesel-powered ships (3) steam supply for industrial process equipment not accessible to steam-distribution lines.

All standardized steam generators had to be built for compactness and portability, simplicity of operation, and reliability. Compactness allowed shop-assembled units or packages to be hauled by standard flat cars or military tank trailers. Simplicity and reliability permitted successful assembly and operation by generally unskilled personnel and required little maintenance.

Both 2- and 3-drum bent-tube boilers, watercooled furnaces with 2-in. tubes, superheaters, and some drum internals, steam dryers mainly, supplied steam under spreader stoker or oil firing.

Interesting was the provision that these units be self-starting. Accordingly a steam-jet stack ring, installed at the base of the stack, connected to the superheater outlet. Steam passing through the superheater in starting up, under a wood fire, cooled the superheater and produced a draft at the boiler outlet. This stack jet produced enough draft to develop 4800 lb per hr of steam without fans. Test results indicated full-pressure operation with coal firing in two hours.

Hydro Utilities. A major program of revamping and renewing a predominantly hydro-powered utility system furnished the material for *New Hydro Plants for Old*, a paper by Frank H Mason, chief engineer, Nepsco Services, Augusta, Maine.

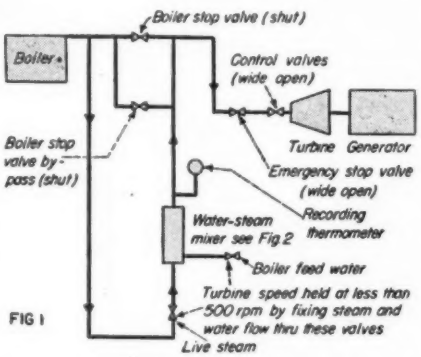
This system, New England Public Service Co, comprised 97 hydro and 9 steam plants for a capacity of 403,000 kw. Many of the plants required considerable redevelopment. One in particular, the Wyman station on the Kennebec—75,000 kw in three separate and complete units—was held up until system loads had grown and showed promise of absorbing output.

Wyman station was among the first stations in its section of the country to (1) be built in semioutdoors design (2) have the core wall of earth section placed by sinking caissons under air pressure (3) have its earth fill placed by tractor trailer and bulldozer rather than by train or sluicing. The spillway consists of gates supplemented by emergency stanchion sections. A long-decked Tainter gate placed under an articulated wide-mouthed float equips the log sluice for about 15-ft pond variation.

Log driving on the station's 12-mile lake has been simplified by dumping logs in the upper reaches before flood runoff. Further, the lake saves water by ponding several billion cu ft each year and holding back enough water to permit control of the river under normal conditions.

Turbine-Deposit Removal. Of interest to all steam-turbine operators is the paper, *The Removal of Deposits From Steam-Turbine Steam Passages*, by G B Warren and T W Howard, General Electric Co. The effort expressed in this paper was prompted by the authors' desire to meet an immediate need for a collection of existing practices on removing deposits and also to stimulate discussion, experiment and criticism that leads to an improved technique.

The paper divides into three headings: detecting deposits, washing and precautions, and nine methods of deposit removal. Most favored method was the tried and true one of feeding


Boiler stop valve (shut)
Boiler
Control valves (wide open)
Turbine Generator
Boiler stop valve by-pass (shut)
Emergency stop valve (wide open)
Recording thermometer
Water-steam mixer see Fig 2
Boiler feed water
Turbine speed held at less than 500 rpm by fixing steam and water flow thru these valves
Live steam
FIG 1

Suggested piping arrangement for saturated steam wash of turbine blades

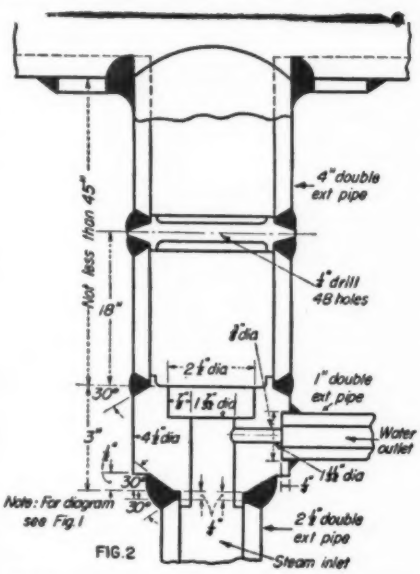


FIG.2

Piping assembly forms a desuperheater for atomizing steam-water mix

an atomized water injection into the steam supply going to the turbine inlet. This system employs fabricated piping to make a desuperheater insuring atomization and maximum velocity for carry-through of water under the low steam flows at the turbine speed used (from 1/5 to 1/4 of normal). Conditions are maintained until soluble deposits wash into the condenser, after a gradual and uniform reduction down to saturation (25 F in any 15 min and not more than 100 F in an hour for turbines of 10,000 kw and above; up to 50 F in 15 min, and not more than 200 F in an hour for turbines below 10,000 kw)

Of the various methods for removing insoluble deposits such as silica, mechanical cleaning is advanced for overhaul periods. Flyash blast, consisting of sifted stack ash applied with proper care to the blading, gives a satin-smooth finish without damage to parent metal.

The ideal condition, of course, would be prevention of any deposit formation by either boiler design or plant operation. In line with this ideal, Walter Leaf, research technician, Denver and Rio Grande Western RR Co, Alamosa, Colo., discussed *A New Process for Removing Dissolved Silica From Water*.

Water supply at Alamosa runs high in dissolved silica, 7.0 grains per gallon, and heavy scaling results from use of this water. Phosphate and tannin in conjunction with magnesium sulphate serve as an internal treatment and succeed in changing the hard scale to a very soft one, but tubes still have to be turbined in spring and fall.

An effort to remove the heavy silica concentration, by ferric salts and caustic, aluminum sulphate and sodium aluminate or magnesium compounds at high temperature, proved effective but too costly for the large dosages required.

Discovery of reduction in silica content of water, by forming hydrous ferric oxide from rusting steel lathe turnings in the water under treatment, led to the following scheme: A wooden tank, 7 ft high x 5 ft dia, is filled with steel shavings up to a few feet from the top. This space at the top has cast-iron chips for filling. A motor-operated rake, with teeth extending eight inches into the cast-iron chips, prevents rust growth "cementing over" the tank. In addition, an air manifold supplies 50 cfm of air under a 100-psi pressure.

Among several quantative tests run with this method of silica removal, one on Denver water, 12-ppm silica concentration, showed, after a few minutes contact with iron chips, a 2-ppm silica content and, after an hour, a trace as indicated by the colorimetric test.

Unit Substations Fit Any POWER System

Load-center equipment offers almost unlimited combinations to fit the needs of industrial electrical systems. L W Long, Allis-Chalmers Mfg Co, describes for power engineers the flexibility of these units and shows how they are applied

Fig. 1—High-voltage roof bushings offer simplest arrangement to connect incoming lines to outdoor unit substations. As roof bushings eliminate need for metalclad switchgear, a nearby pole has to provide transformer protection and disconnecting means

Fig. 2—A plain junction box on indoor unit gives a high-voltage connection comparable to roof bushings for outdoor installations. Again, transformer protection and disconnecting means are provided elsewhere

► Application of load-center units is not limited to a few high-voltage switching arrangements. On the contrary, unit substations have demonstrated their flexibility and adaptability. For example, they offer almost every feasible type of high-voltage termination as standard equipment.

Simplest arrangement uses high-voltage roof bushings, Fig. 1. Bushings eliminate need for the metalclad feature usually inherent in the load-center unit. They are normally limited to outdoor applications, with a nearby pole or switch yard to protect the transformer and disconnect it from the line.

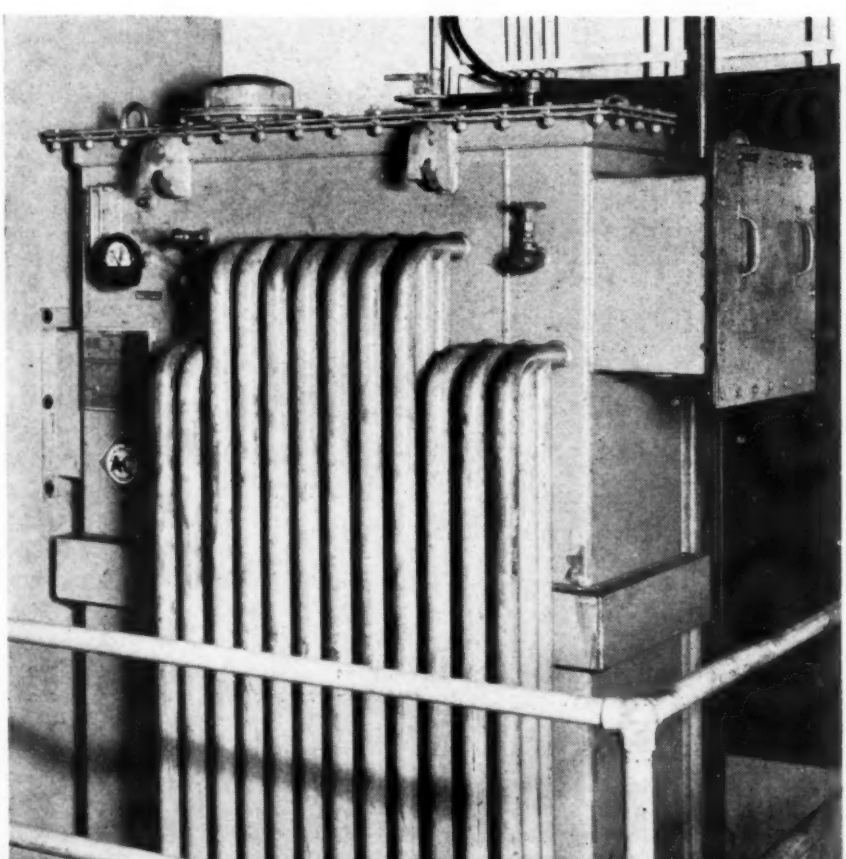
A comparable high-voltage arrangement on indoor units, Fig. 2, is a plain junction box. Like the transformer, it may be liquid filled or dry type. Potheads can be used where voltage and cable require them.

Load-center transformers with roof bushings or junction boxes depend on separately mounted equipment for protection and isolation. This drawback is limited to small installations where only one or two units are fed from remote switchgear.

Disconnect Switch. A more flexible arrangement uses a primary disconnect switch, Fig. 3 and 4. It may have (1) no appreciable interrupting capacity (2) interrupting capacity capable of breaking transformer magnetizing current only or (3) capacity for interrupting load current. Most switches are type (2) or (3).

Switches to break magnetizing current may be immersed in oil, nonflammable liquid or air. Oil-filled switches are normally limited to outdoor applications. Personal preference often figures in selecting non-inflammable liquid-filled switches or air-break switches. Normally liquid-filled switches are used with liquid-filled transformers, but air switches may be used on such transformers. There is no advantage in a liquid-filled switch on a dry transformer. Air-insulated switches have an advantage over liquid-immersed types as potheads can be avoided below 5 kv.

Interlocks. Key or electrical interlocks are used on low interrupting-ca-



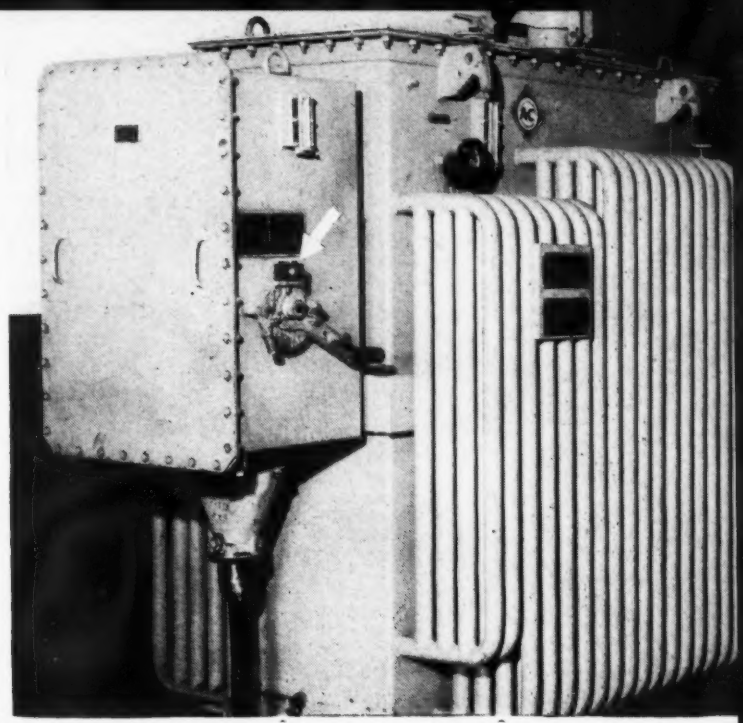


Fig. 3 (above)—Greater flexibility of operation comes from having a primary disconnect switch at the power transformer. These switches are generally capable of interrupting transformer's magnetizing current but sometimes interrupt full-load current. Fig. 4 (left)—The internal view of selector-type primary disconnect switch

pacity switches to prevent opening under load. For a cascaded circuit, the key interlock is simpler, more positive. The interlock works between transformer secondary breaker and disconnect switch. The key must be in position in either device to operate it. The key can be removed from the breaker only in open position. Arrow, Fig. 3 and 4, indicates key interlock used on transformer disconnect switches to prevent opening under load.

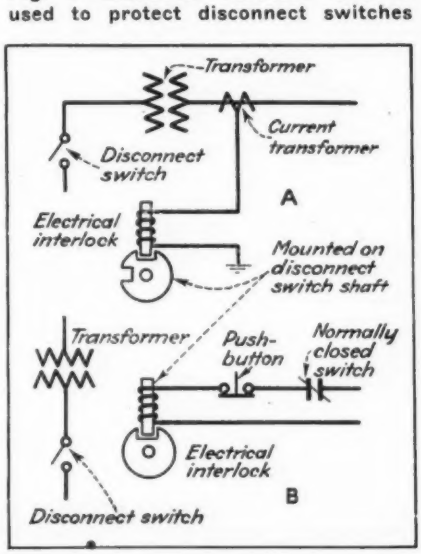
Using a key interlock on substations with direct-connected breakers is often difficult mechanically. Two arrangements are normally used. The first is a leapfrog scheme: First breaker is opened, key removed and inserted in the next. This breaker is opened, the key removed and inserted in the next, and so on, until the last breaker is opened. Key from this breaker releases the disconnect switch. The method requires a number of locks and handling a key from each breaker.

In another method the key for releasing the disconnect switch is held in a box mounted on the switchgear. The key is released from the box only when a key from each breaker is inserted in the proper lock on the box.

Because of the difficulty in using key interlocks on units not having a main breaker, interlocks are sometimes electrical, Fig. 5. One type requires a current transformer in one phase of the low-voltage bus between transformer and feeder breakers. This current transformer can be built into the power transformer itself. Secondary of the current transformer is connected to a holding coil that prevents operation of the disconnect switch when the coil is energized. Since opening the secondary wiring allows operation of the switch under load, this type interlock is seldom used.

A better arrangement has a pushbutton wired in series with a normally closed switch on the feeder breakers. With all breakers open and the pushbutton depressed, a solenoid releases the interlock. Although this arrangement requires more wiring, it is preferable because an open-control circuit prevents switch operation.

Fig. 5—Electrical interlock circuits used to protect disconnect switches



Disconnect switches capable of interrupting primary full-load current are also supplied within certain limits. These are air-break switches, whose design depends on the manufacturer. Because they eliminate interlock keys, load-break switches are becoming popular.

High interrupting-capacity fuses, Fig. 7, can combine with load-break switches to protect a transformer and disconnect it from the line. For this application, boric-acid fuses with condensers are generally used. This type may be too large, as it requires great spacing for adequate air clearance.

Another variety of the switch-fuse combination is the oil-fuse cutout, Fig. 6. Cutout is normally used on voltages up to 5000 and has only 5000 amp interrupting capacity. Both limited voltage range and limited interrupting capacity have restricted the use of these cutouts. They consist of a disconnecting element and a fuse element immersed in a small pot of oil, whose presence also limits their application. However, they do have a definite place in small installations where voltage and inter-

rupting-capacity needs have limitations.

The high-voltage vertical lift metalclad switchgear unit offers the most complete transformer protection. It is also the most versatile switching arrangement.

Basically, such a unit consists of a removable breaker mounted within a welded framework and sheet-metal inclosure. Within this metal housing are mounted instrument transformers, potheads and other auxiliaries. On the hinged front door are necessary meters and relays.

Metalclad switchgear is usable on practically every load-center installation because of the wide range of breaker ratings. Continuous current-carrying capacities from 600 to 2000 amp and voltage ratings of 5000 and 15,000 cover all possible units. Interrupting capacities go as high as 500,000 kva. Breakers operate electrically or manually. Electrical operation makes possible automatic throw-over scheme and allows remote operation.

Relays and Meters. Relays for overload and other protection are a standard feature on all metalclad switchgear. Any type relay that proves useful can be supplied. Differential protection of the transformer can be used. This is not possible with disconnect switches. With induction relays, breaker operation after a fault occurs can be predicted within narrow limits—a definite advantage in coordinating high- and low-voltage breakers. It is also an advantage in coordinating operation with other primary equipment.

Meters can be mounted along with the relays on hinged front panels of metalclad switchgear. An ammeter is standard equipment, but voltmeters, watt-hour meters and all other meters are available. If power-company meters are to be mounted, space can be provided on this panel.

DISTRIBUTION FEEDERS

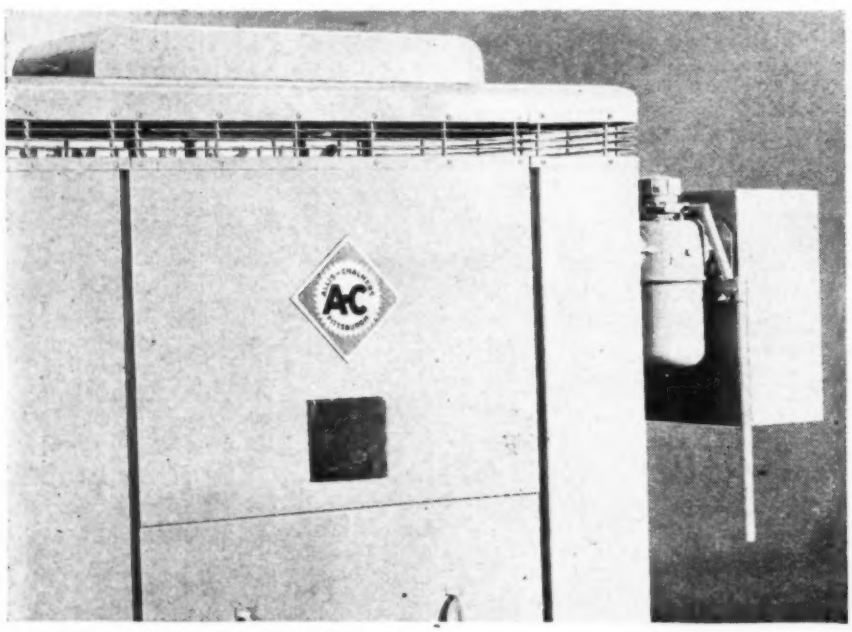
Radial feed is the commonest arrangement for distribution feeders. Usually more than one substation draws power from each feeder. Power goes to the feeder cable through a metalclad switchgear. This unit provides a means of clearing faults in the cable and in the transformer as well, when there is no individual-transformer protection. With only two or three units on each feeder, it is usually not necessary to have more than a disconnect switch on the transformer primary. Transformer failures occur so seldom that the additional investment is not often worth-while.

As in other applications, economy and simplicity, which are of special importance to small plants, offer the main reason for using the radial system. However, this system has its characteristic poor voltage regulation and less service continuity than other systems.

A variation, to provide better continuity of service, uses two sources of power fed through parallel radial systems. Load is split as evenly as possible between the two supplies. With one feeder out of service, the other is relied on to carry total load.

Since both supply circuits must enter each unit substation, this eliminates roof bushings or junction boxes without switches. Selector switch arrangements make oil-fuse cutouts bulky, and are seldom used. Duplicate feeders are usually not justified economically for installations where oil-fuse cutouts are applicable. Disconnect switches and metal-clad switchgear are more suitable. Because automatic throwover is possible, metalclad switchgear is ideally suited for this service.

As is apparent in the foregoing, economic considerations guided development and application of load center unit substations. Because equipment and the theory of its application proved successful in utilities, it is used in industrial plants. Standardized equipment has enabled users of load-center unit substations to reduce four sources of expense: (1) initial equipment (2) engineering (3) purchasing and (4) installation. Without standardization, these savings would be impossible.



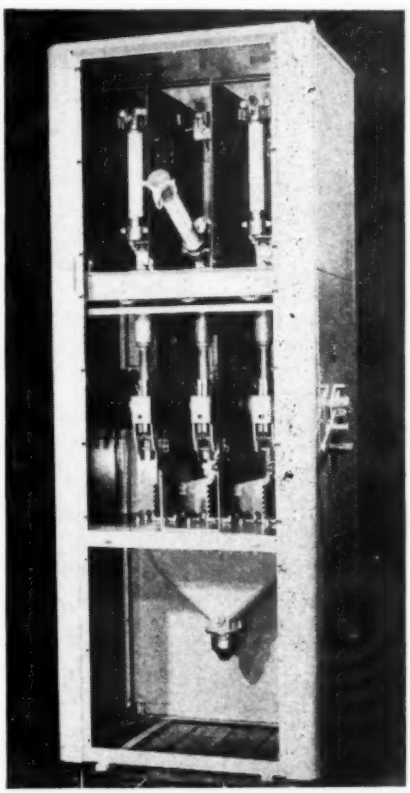


Fig. 6 (above)—Oil-fuse cutouts normally protect circuits whose ratings are below 5000 v and 5000 amp. This limited range in voltage and current restricts the use of these cutouts on unit substations. Fig. 7 (right)—Disconnect switches for interrupting full-load current are generally accompanied by high interrupting-capacity fuses. This combination gives complete protection and provides a method whereby the load center can be disconnected at any time

POWER PERSONALITIES

Men as well as machines make power. Here are on-the-job views of some of these men—their training and experience, their responsibilities, their philosophy of work — the things that make for success in the power field

Clifford J Lloyd, chief power-plant engineer, Wyman-Gordon Co, Worcester, Mass., had worked his way up to a position of "chief" before coming to his present job 15 years ago. Cliff has thought up many new ideas, and put them into practice in adding to and expanding his steam-generating and heating plant. Outstanding among these are: (1) a new idea for air-cooled walls and floors for his horizontal water-tube boilers (2) remotely controlled heating and ventilating system, which directs warm or cool air on the operators in the large open-room forge shop.

Lloyd does all his own engineering, and has found that good judgment and sound engineering are not hard to sell to management.

Having lived in Worcester all his life, Lloyd devotes most of his free time to his family and a home that he has owned for many years. He also likes to drive his car and fish for bass, but finds his main hobby in engineering work. Evidence of this is an active membership in the Worcester Engineering Society and the National Association of Power Engineers. He is past president and present treasurer of the local NAPE chapter, Massachusetts No. 32 as well as secretary of the New England States chapter of NAPE.

WORKED HIS WAY TO THE TOP

Cliff is every inch a power-plant engineer in his blue jacket with a stub pipe in his mouth. He tries to look neat while on the job but always winds up his working day with dirty hands and face; he says he likes engineering so well he cannot get away from it. This is only natural because he started his professional training just after graduating from high school, and has worked at it ever since.

A job as oiler in 1919 in the Worcester Cold Storage plant gave him a toe hold. While working as an oiler, home studies prepared him for a second-class fireman's license. This was put to use immediately on a firing job at the cold-storage plant. While moving from job to job Cliff found time to take a correspondence course from Hays School of Combustion. This course was supplemented by a 4-year course of a trade school specializing in steam engineering.

In time he moved up to a first class fireman, then to third-class engineer, first-class engineer, and finally chief engineer. His first job as chief came while working for Sherman Envelope Co, and in 1931 he came to his present position. Each time Cliff advanced another rung on his way to the top he set to work preparing himself for the next higher level, and each time he became qualified for a better job he always found it ready for him.

He places great emphasis on a clean shop although he found it hard to maintain his standards while burning coal that was available during the war. He both preaches and practices safety. He places as much confidence in his men as possible because he feels it was confidence shown in him by his superiors that helped him work his way up. He never asks a man to perform a duty he hasn't performed himself, or isn't sure is possible. On numerous occasions he has taken the tools and showed a doubting Thomas that the job could be done "just that way."

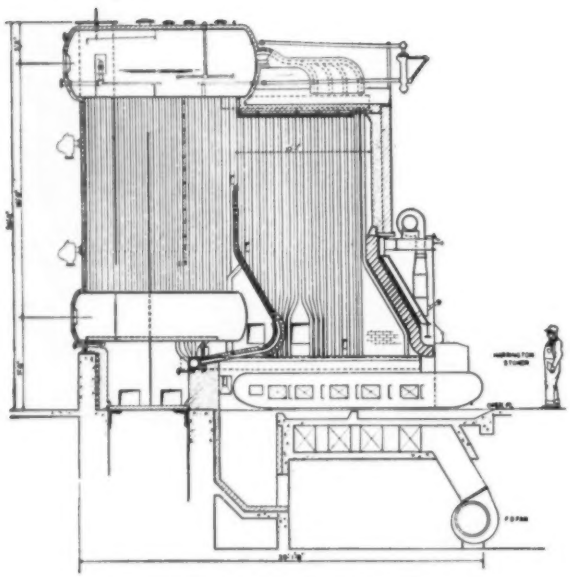
CLIFFORD J LLOYD finds that confidence in his profession and his men is the secret of successful plant operation. Cliff checks daily operating data and collects information which he uses to increase efficiency of his plant

Cliff likes visiting other plants to learn how they are operating so he can pick up ideas for improving his own. He has a pet theory that combustion can be improved, and thinks part of the answer for small-sized variable-load boilers is air-cooled furnace walls. At least, all ideas he has so far tried, have proved his theories correct.

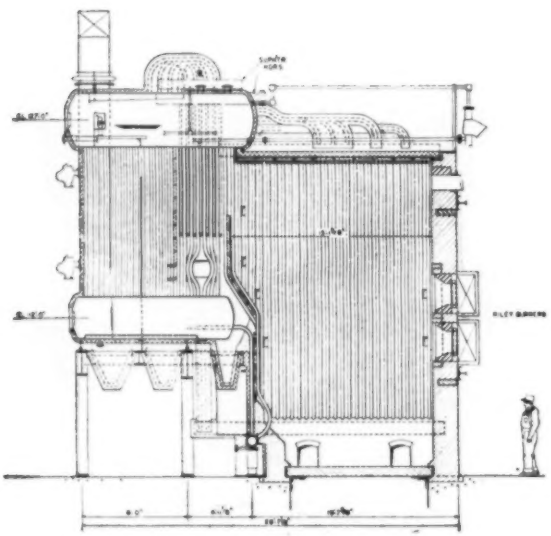
Men who work to improve themselves for their present positions as well as to prepare for an advancement are by far the best men to have on any job, Lloyd thinks. Seven of his 14-man crew are studying for advancement, and Cliff claims some of his most enjoyable hours are spent helping these men. He hopes each one of them becomes "Chief" some day. This is his repayment, through the profession, to the men who helped him advance. It is also his contribution to the advancement of the engineering profession.

He finds engineering the most interesting game in the world. He is a firm believer in the State engineers' license laws and thinks they are largely responsible for the high standards of the profession in the United States today.

Typical Recent Riley Steam



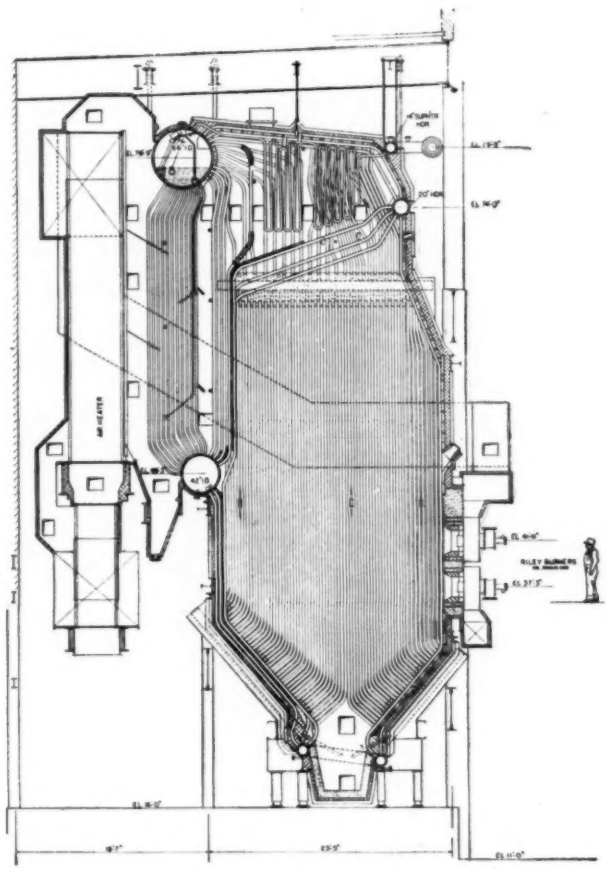
Industrial Rayon Corp., Cleveland, Ohio
55,000 lbs./hr.—180 lbs.—Saturated
Efficiency 77.7%
Harrington Traveling Grate Stoker Fired



Owens-Corning Fiberglas Co., Newark, Ohio
40,000 lbs./hr.—270 lbs.—600°F.
Efficiency 83.5%—Pulverized Coal Fired

These are the types of Steam Generating Units being installed today in so many of the country's leading industrial power plants.

A modern steam generating unit must not only operate at high efficiency but must give long continuous trouble free operation with low maintenance.



Large Eastern Oil Refining Co.
300,000 lbs./hr.—750 lbs.—750°F.
Efficiency 86%—Oil Fired
Future Pulverized Coal Firing

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STOKER CORPORATION, WORCESTER, MASS.

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St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

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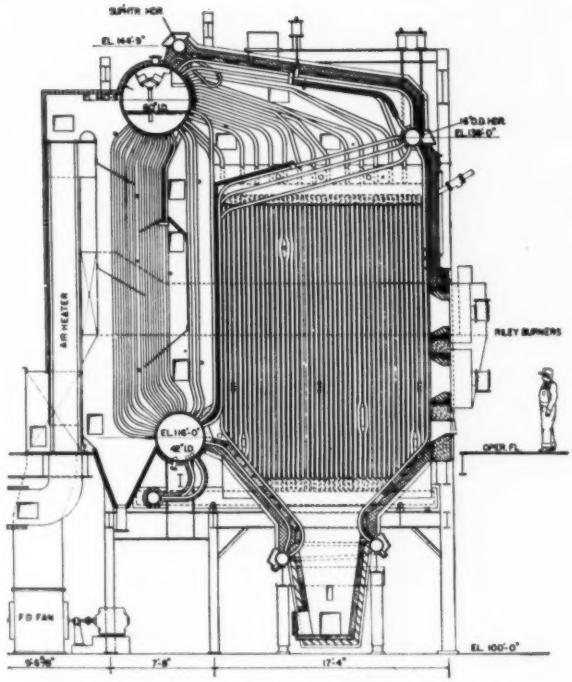
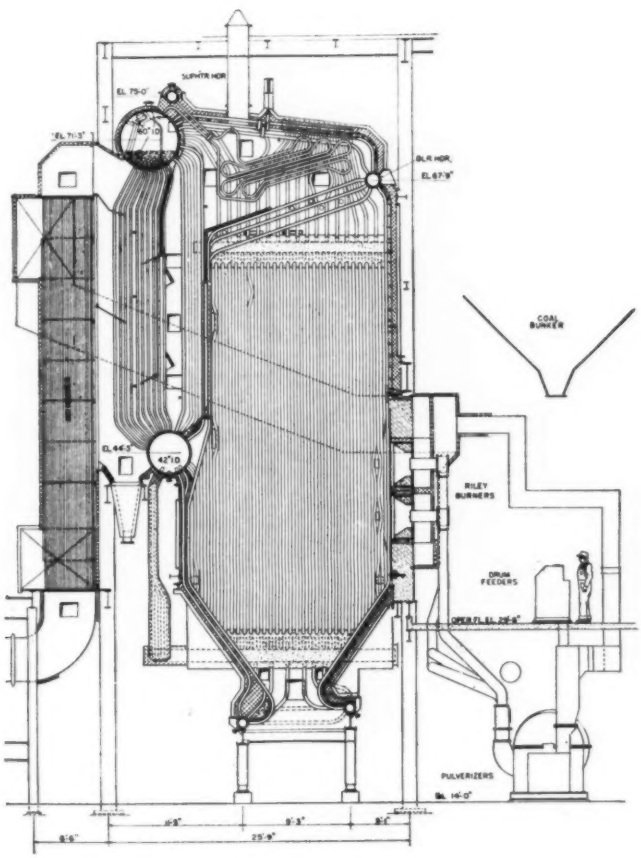
Generating Unit Installations

Because Riley Steam Generating Units give such service—because users are so thoroughly satisfied with the performance of Riley units—because they not only easily meet guaranteed performance but invariably exceed efficiency and capacity guarantees, a decided preference for Riley equipment has developed in recent years. Users know they can rely on Riley.

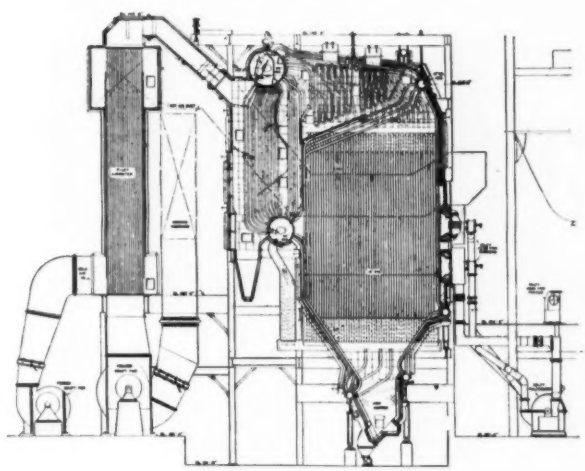
If you are considering new boiler or fuel burning equipment, ask Riley for recommendations. It will pay you to investigate Riley equipment.



Dayton Rubber Co., Dayton, Ohio
100,000 lbs./hr.—550 lbs.—Saturated
Efficiency 85.5%—Pulverized Coal Fired



National Lead Co., Sayreville, N. J.
250,000 lbs./hr.—450 lbs.—637°F.
Efficiency 84.7%—Pulverized Coal Fired



Penobscot Chemical Fibre Co., Great Works, Me.
200,000 lbs./hr.—475 lbs.—700°F. Riley Unit
Efficiency 87.5%—Pulverized Coal Fired

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

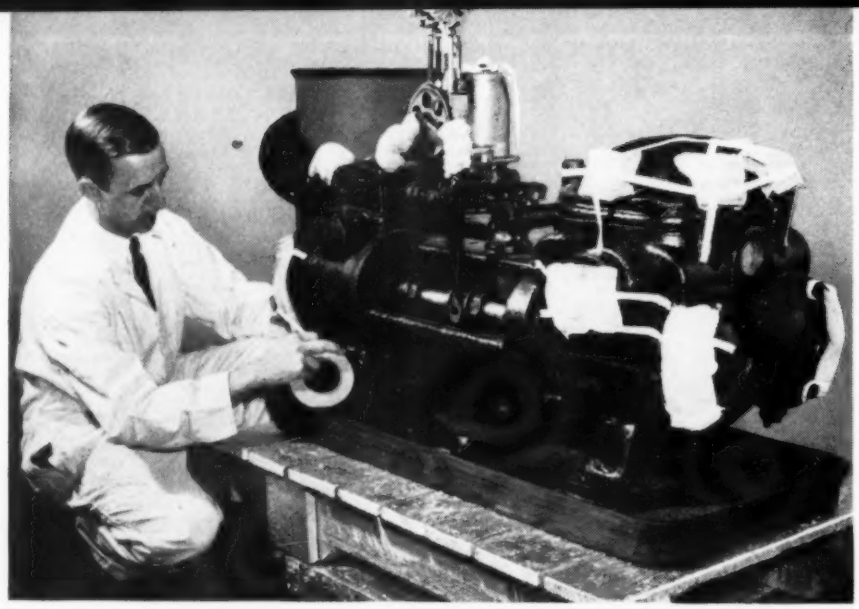
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

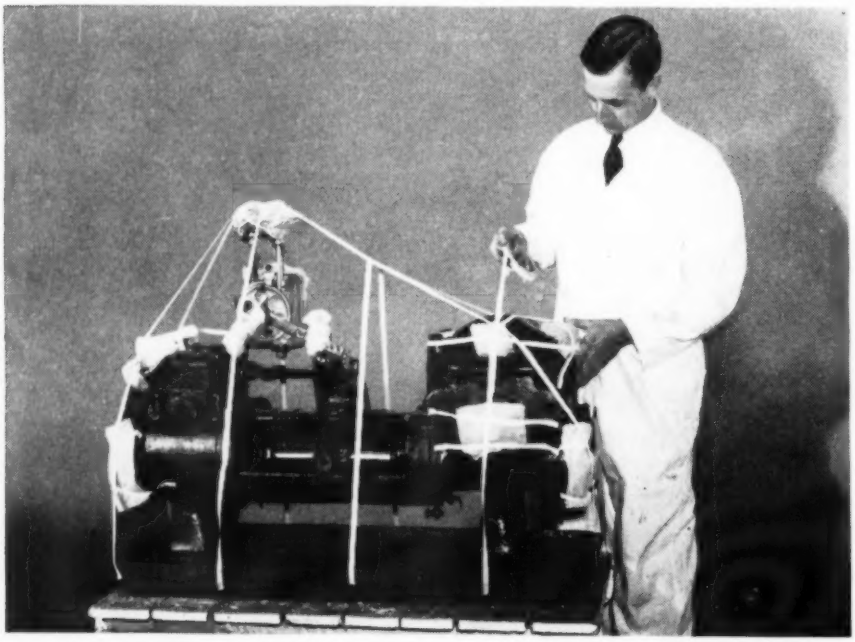
efore purchasing Boiler or Fuel Burning Equipment

SEALED PACKAGE

Protects Machines And Spare Parts



1 If the object to be packaged does not have an airtight base, make one in the form of a sheet-metal pan. Pad all sharp corners with soft material to prevent puncturing the cover and rendering it useless



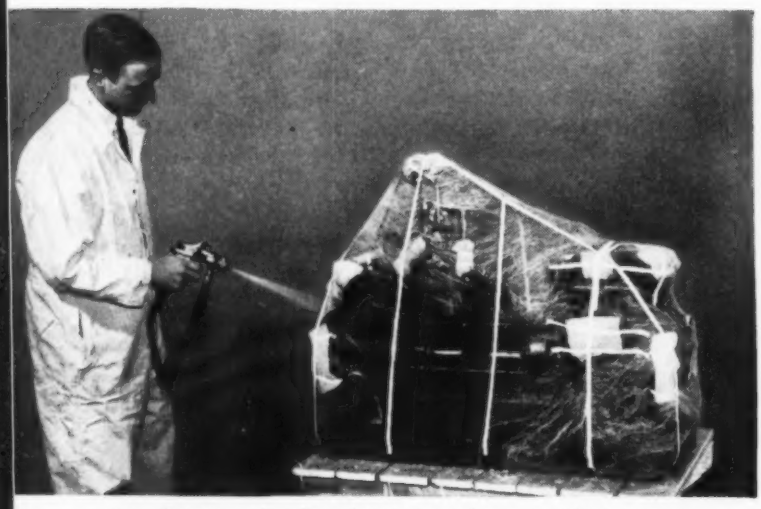
2 After padding is completed erect a tape framework to support the plastic. Distance between tape spans in any direction should not exceed 20 in. because the weblike layer must have ample support

► NO LONGER NEED the size and shape of a machine or spare part loom as a complicated factor when the time comes for storage that must be moisture- and air-proof. New film-forming vinyl resins in volatile-solvent vehicles, used as a spray or dip, provide the object with a skin that is resistant to air and moisture penetration.

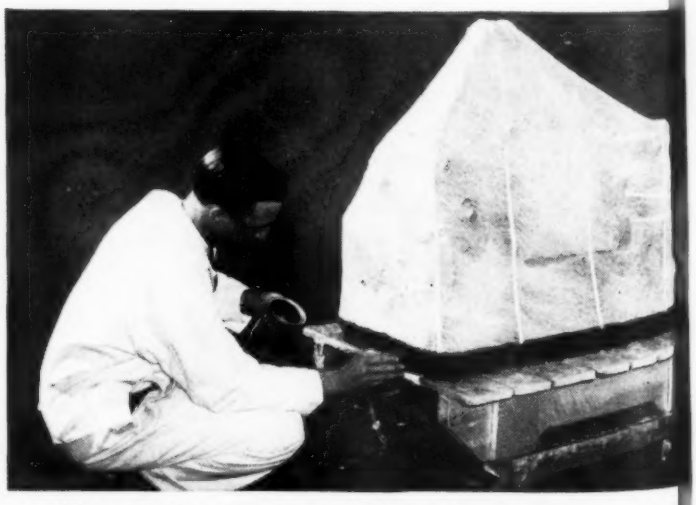
Moisture-vapor penetration varies with coating thickness which, in turn, depends on the individual requirements of a given packaging problem. Transmission rates of different thicknesses are:

Coating thickness, inches	*Transmission 24 hr 100 F and 95 rh grams per 100 sq in.*
0.020	0.350
0.030	0.235
0.040	0.175
0.040 to 0.0625 with Gilsonite-mastic coat	0.05

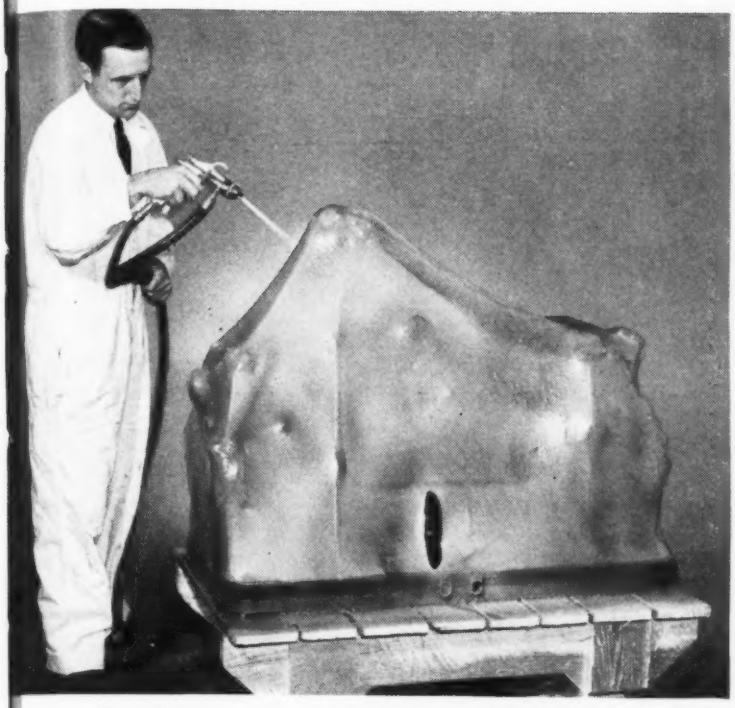
Plastic packaging consists of bridging large openings and voids, up to 20 in. wide, with long weblike plastic



3 Solution for first layer contains a webbing agent. Thus material issues from spray gun in cobweb form, which can be laid across the tape support



4 After webbing coat is completed clean the baseplate and cover its outer surface with cement. This binds subsequent layers of plastic to metal



5 First coat of plastic is sprayed on like paint. It is colored yellow so operator can see when layer is uniform throughout. Open a slit at top and bottom to vent volatile fumes. If necessary, inclosure can be ventilated with compressed air or a remotely-located blower

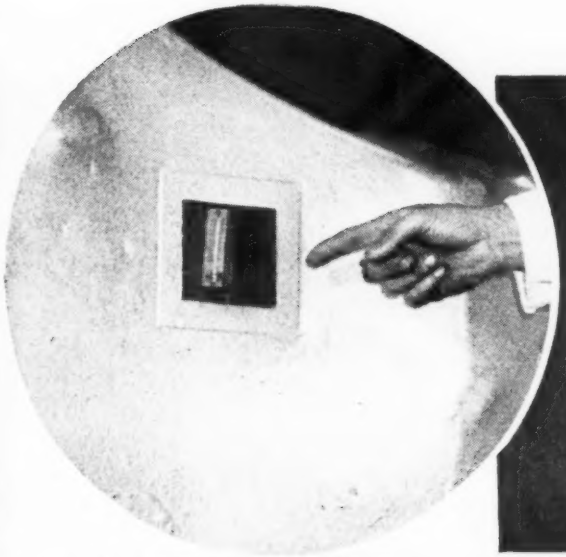
6 Second coat of plastic is colored red to assure complete and uniform coverage. For indoor storage, the third application is coat of aluminum paint; if extreme outdoor conditions are involved Gilsonite-base waterproofing compound is applied before the aluminum paint

filaments that completely inclose the object, and then covering the surface with several coats of liquid plastic.

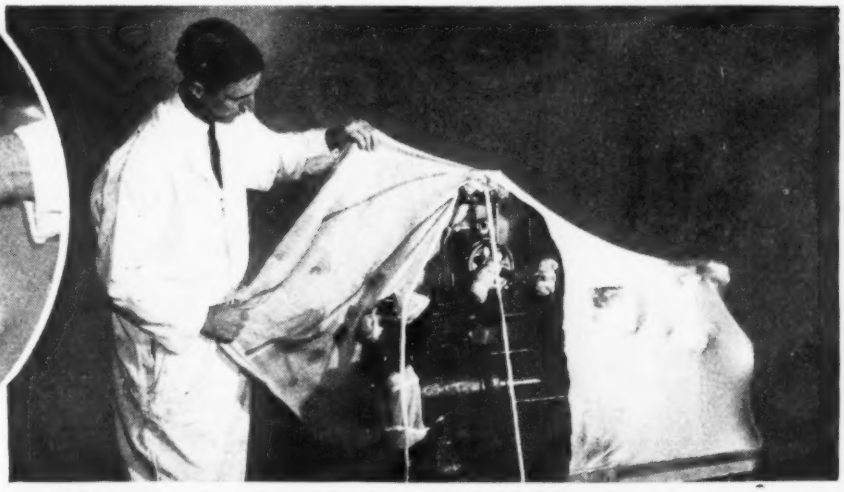
Application of several coats produces a durable, tough and flexible skin. For instance, this coating (1) has tensile strength of 1750 to 2000 psi (dipped coatings average 3000 to 4000 psi) (2) has elongation of over 200% at 70 F (3) remains flexible at sub-zero temperatures (4) does not become tacky at 180 F (5) is resistant to acids, alkalis, oil, grease, alcohol, salt spray (6) is not readily flammable (7) is easy to strip away from part protected (8) can be made to adhere to other surfaces (9) is easy to apply at temperatures of 40 to 120 F.

Advantages are: (1) Machine can be stored in operating condition. (2) Anything from a ball bearing to a generator can be packaged. (3) No time is consumed in applying or removing compound from finished surfaces. (4) It is not necessary to dismantle bulky equipment. (5) Coating protects against mildew and mold. (6) No special equipment is required to do the job—only a conventional paint-spray gun and supply of clean air are needed.

Photos taken for POWER by Densham & Schill at R M Hollingshead Corp, Camden, N. J



7 A desiccant like silicia gel keeps the interior dry. Thermometer, humidistat inside



8 Machines can be packaged in running condition. So preparing them for service requires only stripping the covering and removing the supporting tape grid and padding. Protecting cover peels off

STANDARD
STEAM TRAPS FOR
LOW AND MEDIUM
PRESSURES

The ARMSTRONG TRAPS

Armstrong traps are built to meet specific needs — to solve particular problems. In each case, there is a reason why one Armstrong trap is THE BEST TRAP FOR THE JOB! This is one of the underlying reasons for Armstrong's leadership when it comes to traps. It is also your assurance of COMPLETE SATISFACTION.

Take advantage of the service Armstrong offers. Factory trained representatives are located in principal industrial centers throughout the country. They stand ready to give you authoritative recommendations on how to use traps to IMPROVE PRODUCTION

AIR TRAPS — GASOLINE WATER TRAPS —
OIL TRAPS — ACID TRAPS —
REFRIGERATION
TRAPS —

FORGED STEEL TRAPS FOR HIGH PRESSURES

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COMPOUND TRAPS FOR LOW AND MEDIUM PRESSURES

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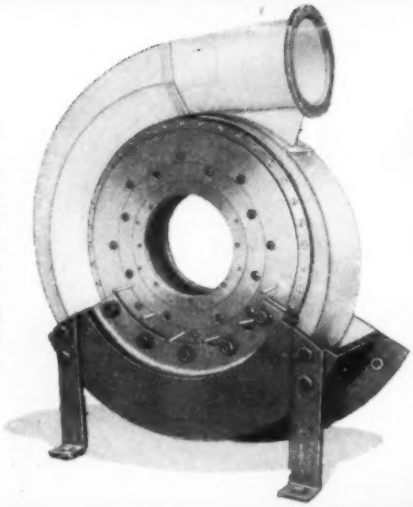
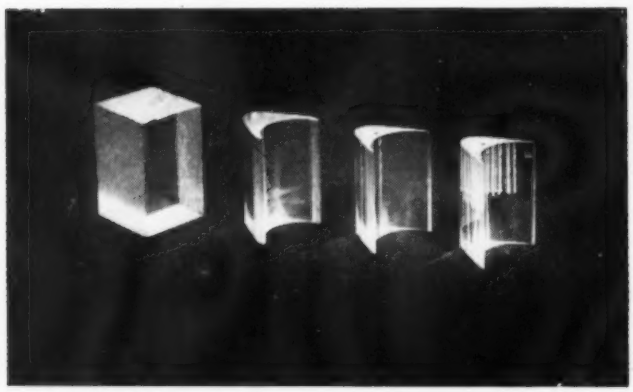
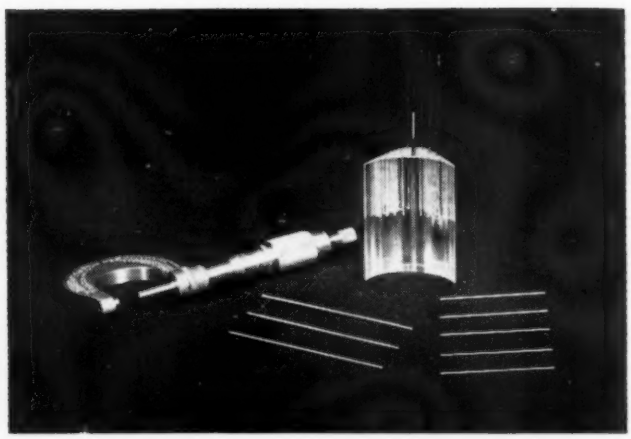
EQUIPMENT MODELS Aid Power Design, Testing and Building



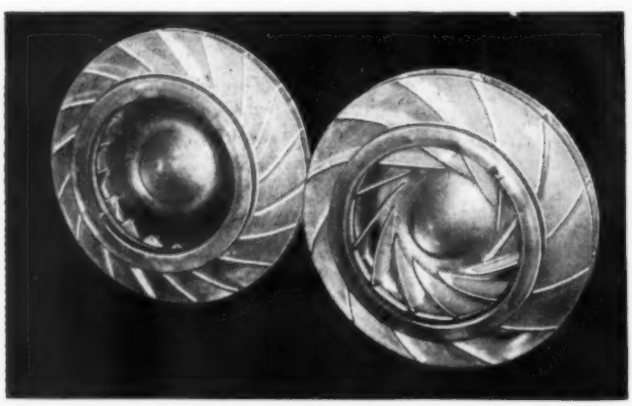
Seven models built by Elliott Company. Right: Blower casing of cellulose acetate enables study of air flow through the scroll. Fabricators of full-scale machine can suggest modifications to minimize building costs



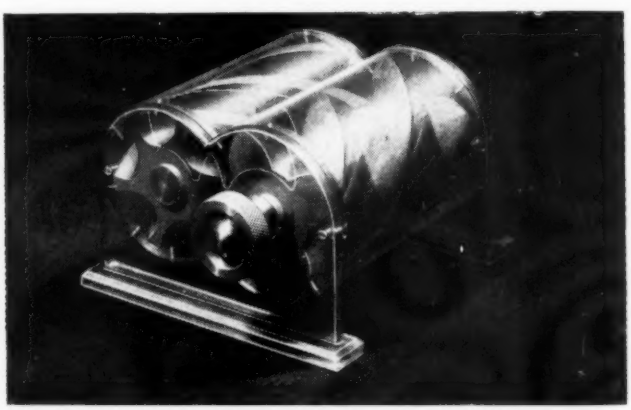
For small-blade development of turbines, testing is made easier by making the Lucite model larger than actual metal blade to accommodate the necessary pressure taps



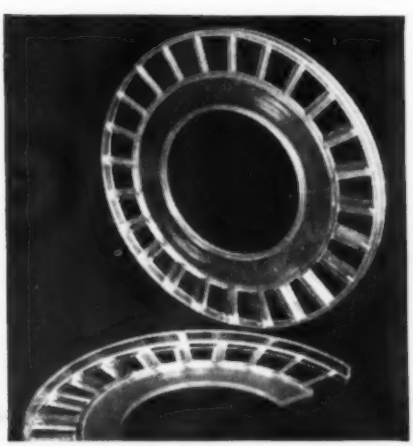
In this blade are 20 pressure taps on blade surface with diameter of 0.0135 in. These holes intersect 0.035-in. holes that run to blade end and are connected to manometers



Blower impellers made of transparent materials are run at speeds up to 7000 rpm. Studies are made with the aid of stroboscopic light and coloring matter in air stream

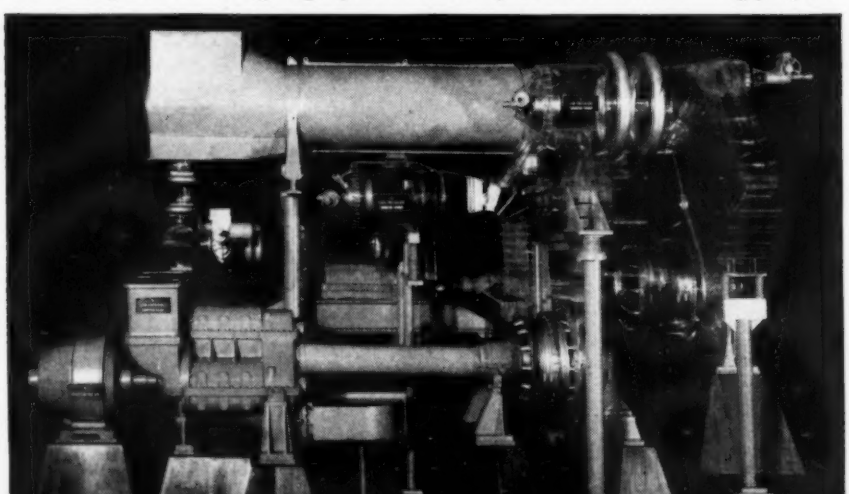


Complex meshing action of Lysholm compressor rotors is readily demonstrated by this model made of well-seasoned walnut wood for rotating parts and a transparent casing



Model diaphragms made for mechanical stress analysis. When loaded, lines of stress are seen by polarized light

Quarter-scale model of Elliott 2500-hp gas-turbine plant built for U.S. Navy. This model greatly aided sheet-metal workers in building actual machine, as well as engineers in designing layout. Assembly now used for teaching purposes



DEPRESSION IN '47?
...controls can bring one

IT IS CONVENTIONAL for the American business man, who values freedom, to protest against government regulation. On this account, many people who do not know the facts in detail are inclined to discount current business protests against the post-war application of wartime economic controls. This is particularly true since in his report for the third quarter of this year, the Director of War Mobilization and Reconversion implied that business is in fine health by remarking that "business profits, after taxes, are at the highest point in history."

In complaining about government controls, however, the American business man is not crying wolf. These controls were an essential war weapon. Now, however, they are contributing decidedly to a twisting and distorting of the American economy in a degree which, if not soon corrected, may well start production and employment down the toboggan.

One general indication of how badly twisted our economic system has become is found in the wide disparities in the amounts by which different groups of prices have increased. Since 1941, for example, farm prices have advanced an average of about 125%. Industrial prices, more tightly controlled than any other group except rents, have increased only about 32%. Meanwhile, straight time hourly earnings of industrial workers have gone up about 60% and the cost of living about 43%.

The advances of individual prices within these groups have also varied enormously. Among industrial prices, that of finished steel has gone up only about 14% since 1941, while lumber has gone up over 50%. Hourly wage rates in the women's garment industry have gone up 116%, while those in the brewing industry have gone up only 33%. That share of the cost of living due to rent has gone up only 4%, while that due to the cost of clothing has gone up over 60%.

Well, What Of It?

At least four things of major importance:

1. Production, under the influence of price control, has been heavily concentrated in some lines to the neglect of others. Result—unbalanced production, unbalanced inventories, and a serious cut in the flow of goods to consumers.

2. More or less uniform post V-J Day wage increases, promoted by the federal government, have imposed a far more serious cost problem on some industries than on others. This is particularly true of some of the most basic industries.

3. While, as a whole, "business profits, after taxes, are at the highest point in history" (due in part to a temporary excess profit tax rebate arrangement) there are enormous disparities in the profits of different industries. Some key industries are making little or no profits.

4. **If not corrected, the distortion of prices, wages and production, which has resulted in such a wide disparity of profits, can contribute decisively to a major business upset.**

The most striking example of the distortion of production by controls was, of course, that provided by a metropolitan meat famine at a time when beef cattle crowded the ranges. This has now been recognized. But there are many other distortions. Abundance of sports clothes, acute shortage of more essential clothing made from the same kind of cloth. Successive shortages of critically important products like baling wire and nails as the price lid on steel is jiggled first this direction and then that.

Some of these distortions of production are due to material shortages. But a major contributor is uneven application of controls, and the total removal of some while others are held firm. Among the results are bulging inventories of partially completed assemblies and shut-downs while waiting for parts.

Wage Complications

While price controls, unevenly applied, have shunted production first this way and then that, the federal government has further complicated the situation by promoting uniform wage rate increases without regard to varying capacities to pay them. The greatest single contribution to this distortion was made by the President himself. In the course of

unsuccessfully trying to mediate the dispute over steel wages last January he recommended a wage rate increase of 18½ cents an hour. Immediately that increase was accepted by organized labor as par for the first round of wage adjustments, having the sanction of the White House itself. The game then became to beat par.

But the capacity of different industries to pay wage increases varied greatly. During the war some had hiked their pay much more than others. Moreover, in some industries wages are a much larger element of total cost than in others. In 1939 (last year for which figures are available) wages ranged all the way from 2½% of total sales in cigarette manufacturing to 34.3% in hosiery manufacturing and 65.2% (for wages and salaries combined) in soft coal mining.

Under these circumstances, some industries were far less able to meet a uniform wage increase than others. Nonetheless, many of them had uniform wage increases imposed upon them. Then the price lid was held firm. This, coupled with material shortages and production difficulties which also choked output, squeezed the profit right out of those industries.

A Study In Contrasts

Some of the most important industries are making little or no profits while they bump along on a production volume which fails to meet consumer needs and prevents attainment of maximum efficiency. The automobile industry affords one conspicuous example. Another is electrical manufacturing, and rail equipment is yet a third. All of them are crucially important. Many other lines of business, of course, are extremely profitable. For example, the profits of a group of large retail stores were 150% higher during the first half of this year than they were a year ago; the profits of a group of motion picture companies were up 140%.

In the meantime, the workers in some of those low-profit industries are in no bed of roses. The increase in the cost of living since 1941 is now outstripping the increase in the hourly wage rate of workers in a number of industries, where wage rates have not risen as much as the average. On a weekly basis, a shorter work week, with less overtime, has combined with the recent upsurge in consumer prices, to place the living standards of some of these workers below the wartime level.

Such circumstances obviously create pressure in the ranks of these workers for another round of wage increases. But as long as the profit remains squeezed out of their industries wage increases, if any, must be translated either into higher prices, or, if the government sits tight on the price lid, into losses which will discourage production and ultimately cost workers their jobs.

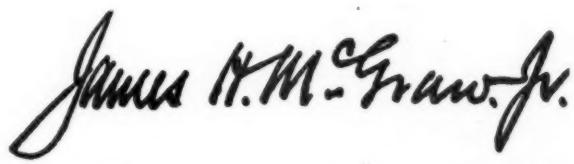
What To Do?

Salvation both for the workers and for employers in the relatively profitless section, a peculiarly important group of industries, must be looked for primarily by increasing productivity, thereby decreasing the cost per unit. Part of this higher productivity can come only from individual efforts of the workers themselves. Another part can come from an elimination of bottlenecks in materials and parts which prevent the labor force from working most efficiently. Only by greater output per man-hour can workers and management solve their common problem.

Until productivity has been thus increased, it is hard to think how the federal government could do a greater disservice both to labor and to industry than to repeat its performance of promoting a uniform national wage increase. With the present distortion of the national economy, some industries might again take such an advance in their stride. With many others it would raise even greater havoc.

While avoiding like the plague promotion of another uniform wage adjustment, the federal government must make it a primary objective to relieve distortions caused by the uneven application of other controls, primarily price control. Nature has given a lift to the elimination of distortions by providing bumper grain crops which should in time reduce that staggering disparity between a 125% increase in farm prices and a 32% increase in industrial prices. But that process must be speeded as a matter of conscious policy. No element of such a policy is more important than expediting the decontrol of industrial prices. Such a course is clearly essential to achieve that balance in the production of materials and parts required for maximum output.

Business and labor both want a sustained prosperity in which all will share. Sustained prosperity can be achieved only if we eliminate the distortions in wages, prices and profits which now restrain so much vital production.



President McGraw-Hill Publishing Company, Inc.

THIS IS THE 52ND OF A SERIES

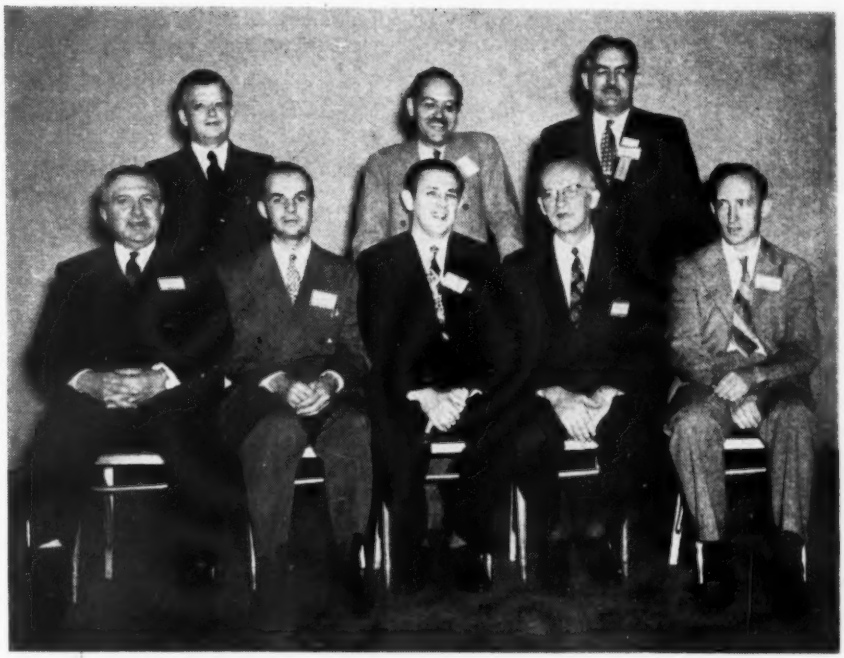
Pneumatic Instruments Need Clean, Dependable Air

Avoid costly process interruptions by selecting an instrument air supply that is constant and uncontaminated

► MEETING for the first time since a few isolated groups of instrument men organized it, The Instrument Society of America convened at Wm Penn Hotel, Pittsburgh, Sept. 16-20. They examined new instruments and controllers of 120 manufacturers, and heard fellow engineers speak on related subjects. Joint sessions were held with Industrial Instruments and Regulators Div, ASME, and the Physical Society of Pittsburgh.

Of interest to power engineers is the paper, *Design of Instrument Air Supply System for the Process Industry*, by W C Ludi, Standard Oil Development Co. He stressed the fact that air for controller operation must (1) be clean and dry (2) have a steady pressure and (3) have a reliable supply source. Air failure for even a short time upsets the process for a lengthy period.

At first glance a plant air system may appear a good supply source. However, this is not entirely true because it serves many purposes that often demand such quantities of air that pressure is materially lowered.



Front row: C F Kayan and H H Barnum, ISA vice-presidents; A F Sperry, past president; C O Fairchild, president; R D Munch, vice-president. Second row: H E Ferguson, treasurer; R Rimbach, secretary; J B McMahon, vice-president

Cleanliness. All foreign matter must be kept out of air flow because orifices, nozzles and pilot valves, being small, are easily plugged by dirt, gummy oil, etc. In one plant the air system supplied the controllers and also emptied caustic lines. Failure of check valves permitted caustic to back up into the air line and reach the controllers. This seriously corroded the mechanism.

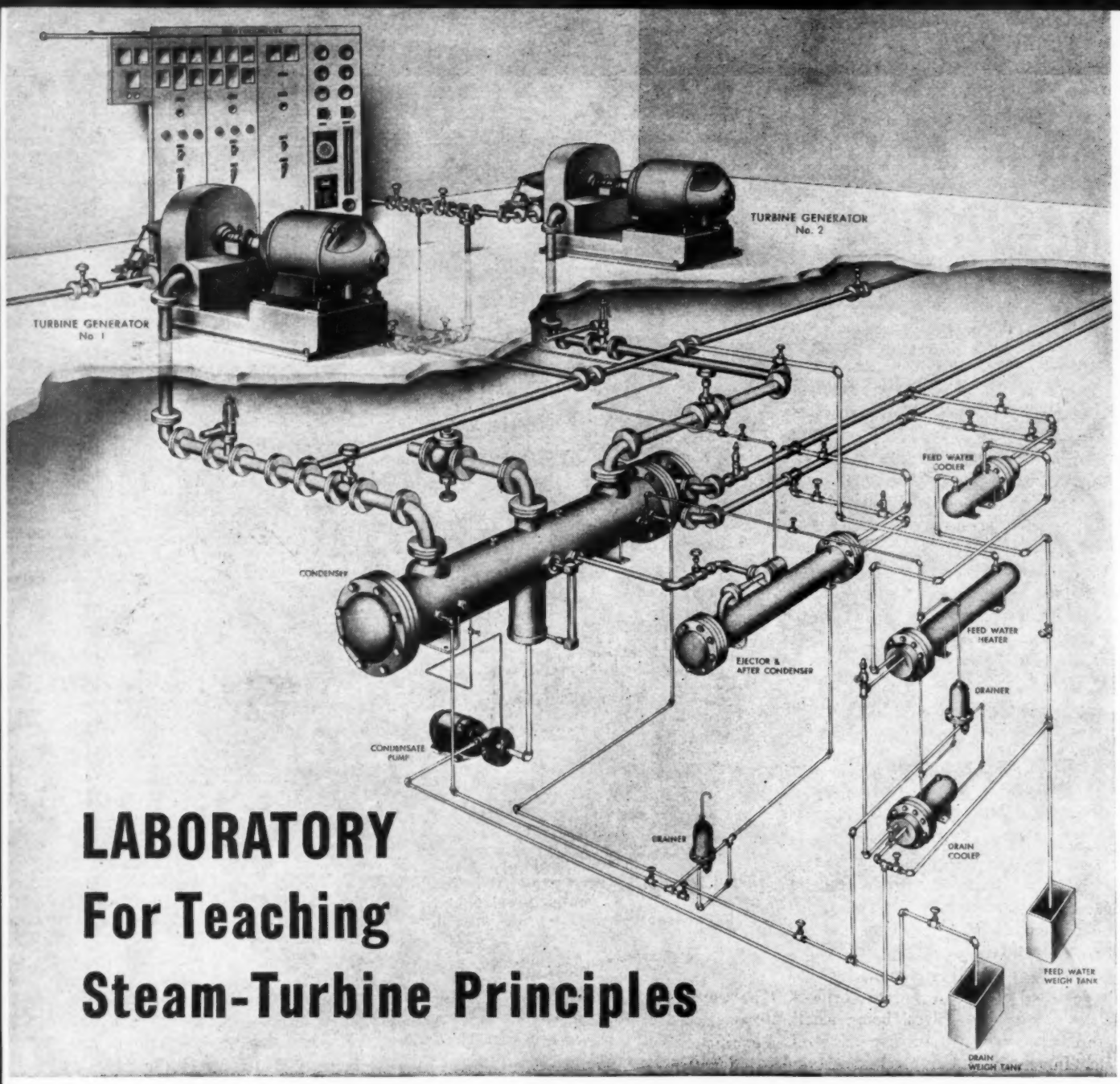
Dryness. Moisture in the air causes unreliable instrument operation because: (1) Freezing shuts off air supply. (2) Moisture corrodes piping and forms rust. (3) Water and entrained oil become emulsified and foul the mechanism.

Several types of air systems meet the principal needs: (1) Central system, entirely isolated for instrument use only, requires compressor, aftercooler, moisture separator, air receiver, drying apparatus and distribution system. (2) Use plant air compressors if reliable, but give instrument use preference over other uses. Take supply direct from receiver, and install control equipment so other services do not drag pressure below a safe minimum. Use an adequate separator and drying equipment. (3) Use regular distribution system but install drying equipment and auxiliary compressor at each takeoff area that cuts in automatically if plant pressure fails. (4) Install individual air supply at each process unit or area. This is similar to (1) but is on a smaller scale. Only drawback is difficulty of obtaining compressors that have long life with low oil carryover.

Pressure Needs. Most instruments require air at about 20 psig. Because pressure-reducing valves perform satisfactorily with 5-psi drop, valves need at least 25-psig supply pressure. Leeway for flexibility dictates that this pressure be 35 psig to meet all conditions. Further 10-psi allowance for drop through drying apparatus and distribution lines requires 45 psig at the central compressor station.

When designing an air supply station for instruments allow 0.5 cfm of air for each pilot. For instance, if an instrument has a nozzle and pilot valve use a factor of two etc. Experience shows that valve positioners should have a factor of two also. Knowing the number of instruments, apply the necessary factors to get the equivalent number of air users and multiply by 0.5 to find the required amount of air-compressor capacity. Add 15 to 20% for blowdown and future instruments and select two heavy-duty continuous-service compressors (one a spare) of this capacity. Avoid machines that use the splash system of cylinder lubrication. Select drying apparatus capable of maintaining a dewpoint temperature of 40 F in summer and −10 F in winter. When designed for summer conditions they are usually amply large for winter.

Educational. In addition to the many technical meetings "short courses" were given on instrument fundamentals under the direction of Dr B R Teare, Jr, head of the electrical engineering department, Carnegie Institute of Technology, and chairman of the educational committee of the instrument society.



LABORATORY For Teaching Steam-Turbine Principles

Fig. 1—Complete laboratory equipment and piping arrangement as suggested for installation in engineering schools

Newly designed steam-laboratory turbines for installation in engineering schools enable duplication of many practical arrangements for study, testing and operating manipulation

▶ STEAM LABORATORY EQUIPMENT of novel design, soon to be installed in a number of engineering colleges, will greatly facilitate teaching steam power-plant theory and practice. Designed by Westinghouse in collaboration with Prof R B Rice, North Carolina State College, this machinery will enable the student to acquire knowledge of (1) power-plant operation (2) basic arrangement of steam-turbine electric-generating plant (3) industrial applications of steam turbines and (4) accepted test procedures under actual use.

The laboratory plant, consisting of two independent turbine-generator units, is arranged for easy accessibility and testing of each basic part, as well as for operation as a unit plant. By simple manipulation of steam valves and electrical connections the entire gamut of steam-turbine power-plant cycles can be simulated. Fig. 1 shows the principal pieces of equipment with a suggested piping arrangement.

Steam Equipment. Each turbine is a single-stage 2-row velocity-compounded impulse unit, flexibly coupled to a 25-kw 80%-pf 31.25-kva 3-phase 60-cycle generator operating at 3600 rpm. The turbines operate condensing or noncondensing up to a maximum backpressure of 50 psig. In addition to a speed governor and speed changer on each unit, No. 1 turbine has a backpressure governor and No. 2 has an inlet-pressure governor.

While No. 1 turbine is arranged to operate as a high-pressure unit only, No. 2 is specially nozzled to operate

either as a high-pressure turbine receiving steam from the high-pressure header, or as a low-pressure unit taking steam from No. 1 turbine exhaust. Each unit is arranged with two hand valves, and a wide selection of the number of nozzles under governor control can be made. In this way, a student compares the effect on power-plant efficiency of multi-valve operation, as used on large turbines, with single-valve throttling control for small turbines.

When the turbines operate in series the equivalent of a multistage unit is obtained. From the steam connection between the two turbines steam can be extracted automatically or nonautomatically at an intermediate pressure, or it can be inducted. If desired, steam from high-pressure-turbine exhaust is first passed through a reheater before entering the low-pressure-turbine inlet.

TURBINE GOVERNING

The governors are arranged so the over-all regulation of each unit is adjustable. With the two units operating in parallel, load division as effected by turbine regulation can be studied for equal regulation as well as for widely different regulations. Hand speed-changers on the governors permit operation over a range of speed. The student can study governor functioning with changing load and speed-changer setting, and can transfer load from one unit to the other, as well as control unit speed for synchronizing when starting up a turbine-generator and placing it on the line for normal operation.

Fig. 2 shows the flexible piping arrangement for the laboratory plant. Note that one surface condenser is used for both turbines. An atmospheric relief valve, included as an operating precaution, simulates power-plant practice. The single-stage air ejector mounted on an aftercondenser uses raw water as the cooling medium. The aftercondenser condensate normally flashes to the surface condenser through a drain trap, and during tests it can be separately measured in a weigh tank.

FEEDWATER SYSTEM

To permit determining condensate-pump suction head a gage glass is mounted on the condenser hotwell. The single-stage condensate pump operates at 3550 rpm, and develops a 168-ft head at 5 gpm with 16-in. submergence. This high head keeps the feedwater from flashing into steam as it is heated in the heater.

Feedwater-heating equipment includes a single-stage heater with a drain cooler for cooling heater drains before

By *F K FISHER, Steam Division*
W R HARRIS, Industry Engineering Dept
Westinghouse Electric Corporation

flashing them back to the surface condenser. To permit accurately determining water quantity during feedwater-heating tests a feedwater cooler is included. It reduces feedwater temperature and prevents weighing inaccuracies caused by flashing to steam.

Effect of air leakage on condenser performance and dependence of condenser vacuum on air-ejector air-removal capacity can be demonstrated and made the basis of considerable special testing. The condenser and feedwater heater, in addition to their use in regenerative feedwater heating, offer a wide variety of possibilities in liquid-heat transfer and condensation studies.

In operating the units under various

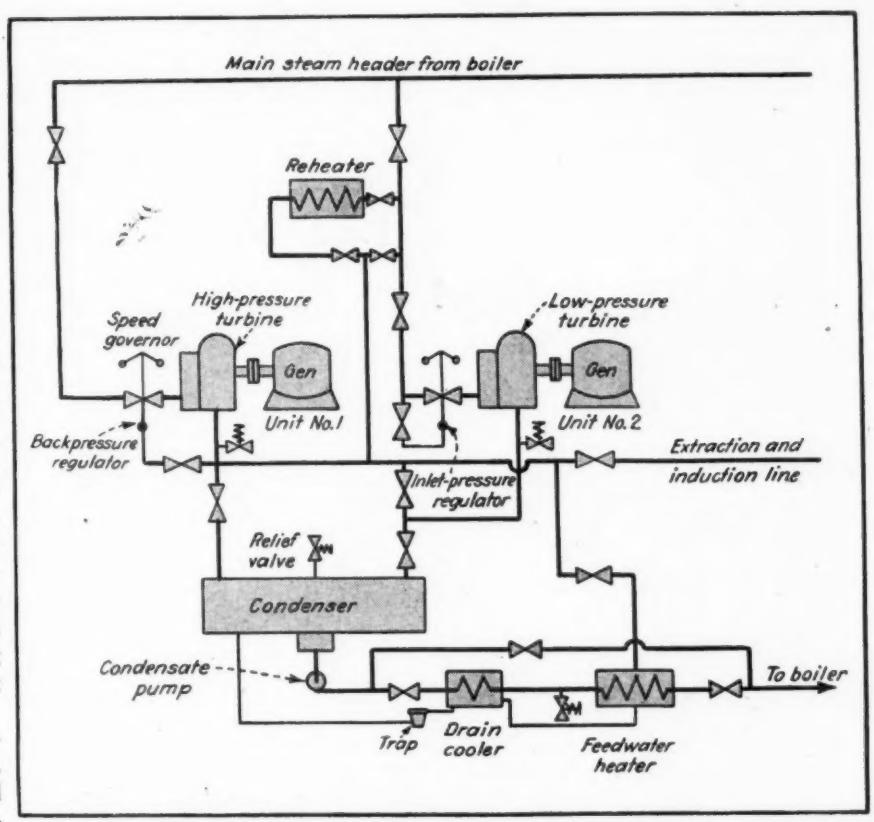


Fig. 2—Piping of steam-turbine laboratory equipment, together with alternate pressure or speed control on turbine inlet valves, can simulate 15 arrangements

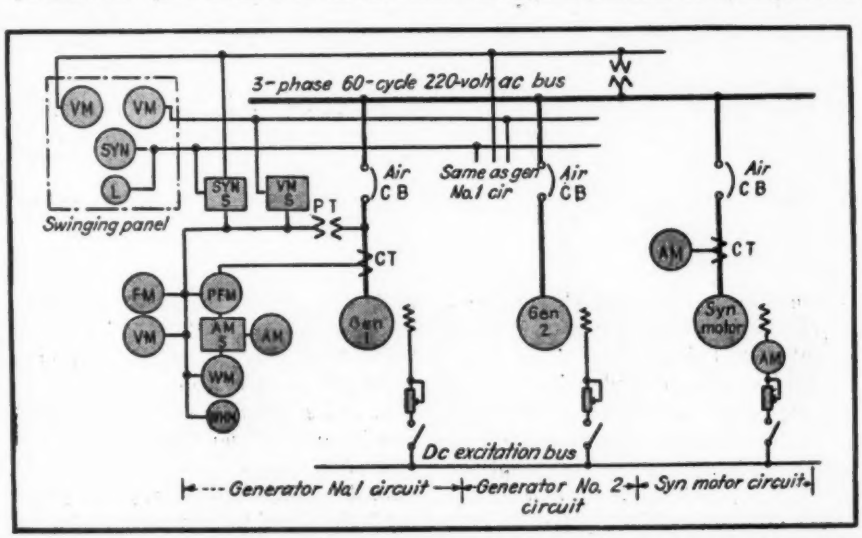


Fig. 3—Single-line diagram of main electrical circuits of steam-turbine laboratory plant when using a synchronous motor for loading turbine-generators

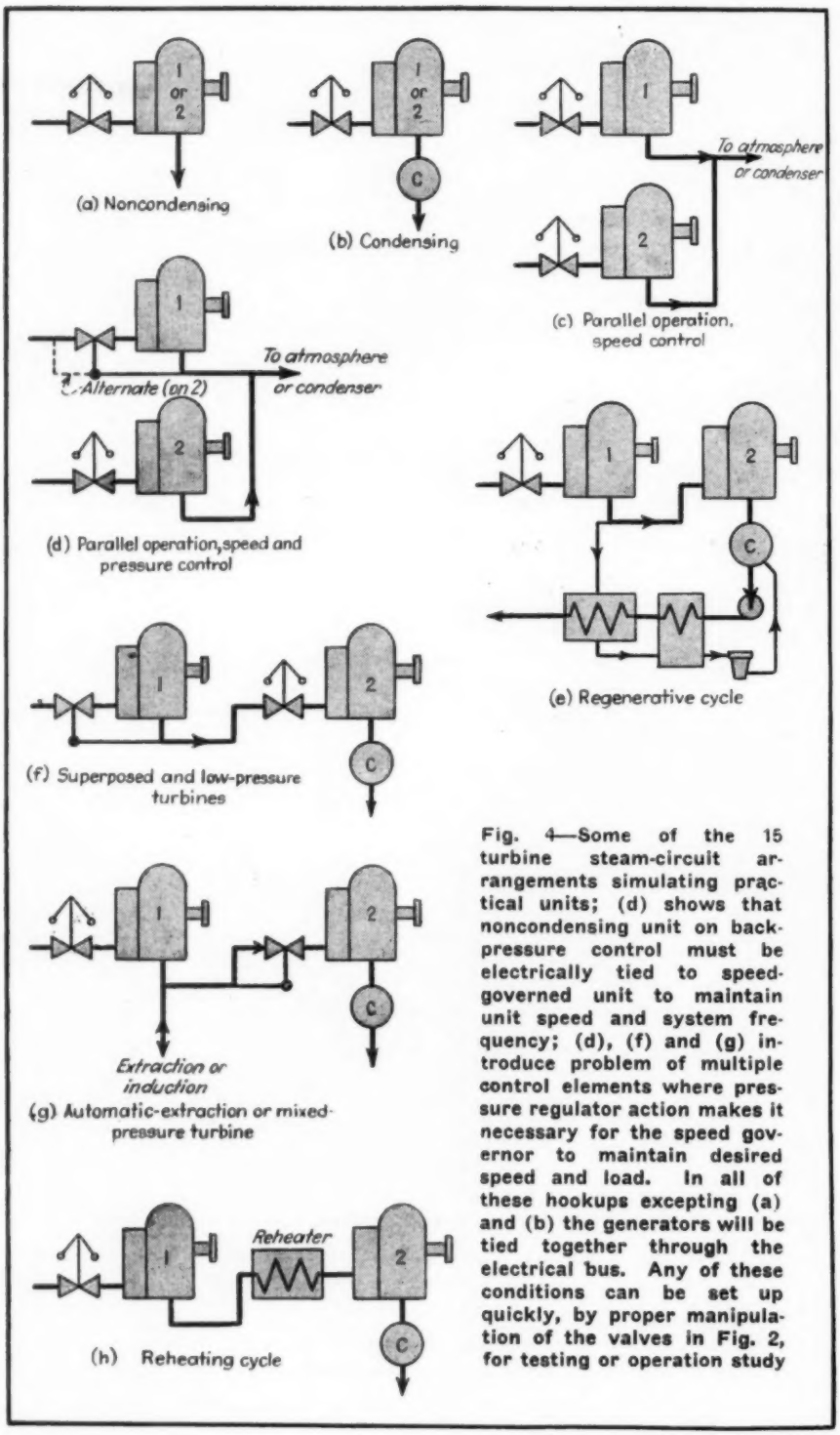


Fig. 4—Some of the 15 turbine steam-circuit arrangements simulating practical units; (d) shows that noncondensing unit on back-pressure control must be electrically tied to speed-governed unit to maintain unit speed and system frequency; (d), (f) and (g) introduce problem of multiple control elements where pressure regulator action makes it necessary for the speed governor to maintain desired speed and load. In all of these hookups excepting (a) and (b) the generators will be tied together through the electrical bus. Any of these conditions can be set up quickly, by proper manipulation of the valves in Fig. 2, for testing or operation study

arrangements, some of which are shown in Fig. 4, the proper use and functioning of control elements as well as basic principles in their application can be demonstrated. There are nine basic types of steam-turbine applications, which together with six modifications make a total of 15 possible arrangements that are used in practice.

Electrical Equipment. This equipment consists of duplicate 31.25-kva 80%-pf 3600-rpm 3-phase 60-cycle 220-v turbine-driven generators and either a 60-hp 80%-pf synchronous motor or a resistor bank for loading the generators, and a complete set of switchgear. The latter simulates the apparatus and protective devices found in any modern central station or industrial power plant, but is simplified to provide ease of operation, and arranged so the student may readily understand the operations he performs as he manipulates controls.

Synchronous-motor loading has an advantage over the resistor bank because the power factor as well as load can be varied. Power-factor variation obtained by rheostatic control of motor field strength may be adjusted from leading to lagging within the equipment rating. The motor may be connected to a water brake or other suitable means for absorbing its power output and varying the loading.

While not as flexible from the electrical standpoint, a resistor bank forms an adequate means of loading and has the advantage of greater simplicity of apparatus and operation.

PLANT INSTRUMENTATION

The deadfront switchboard, Fig. 1, provides complete instrumentation and control for the electrical system. It consists of a swinging panel for synchronizing instruments, an individual panel for each generator and a panel for the synchronous motor or resistor bank. Control and instrumentation details are shown in Fig. 3.

Mounted with the electrical switchgear is a gage-and-instrument panel for indicating the various steam conditions. Each turbine is equipped with an initial steam-pressure gage, a nozzle-chamber pressure gage, an exhaust-steam pressure gage and a pressure-governor regulator. Space is available for mounting additional devices, such as manometers, indicating or recording pyrometers, and the flowmeters that each user may desire.

Apart from its use with the steam apparatus, the electrical equipment is suitable for demonstration and study of many principles. These include standard tests such as reactive-kva distribution and voltage control for parallel operation, synchronizing, and short circuit. In addition, the equipment is particularly suited to special tests such as synchronous starting of various combinations of generators and motor, and to study of the problems of starting a motor at rated voltage and frequency where the motor size is large in relation to system capacity. Problems of this type, which frequently arise in industry, often require thorough and precise evaluation of the factors involved in reaching a workable solution.

The complete power plant has been carefully coordinated to provide the utmost in flexibility and adaptability for a laboratory. Although full-scale equipment is used it meets the most important criteria for laboratory apparatus: economy of space and power consumption without sacrifice of basic characteristics.

Steam-Plant Design Promotes Good Housekeeping

Dust-tight construction in the coal and ash systems, intelligent use of light-colored paint, and flood lighting along the walls make it easy to keep this modern plant shipshape

▶ CHARTERED BY the South Carolina legislature Dec 15, 1845 with $300,000 capital, Graniteville Co has been on the job continuously for a century. It is the oldest Southern cotton mill operating under an original charter. Built of granite from quarries at Graniteville, S. C., it has hummed with thousands of spindles and hundreds of looms since 1849. Vaucluse, Hickman and Warren Mills and Gregg Dyeing Plant were built nearby, and in 1940 Sibley and Enterprise Mills in Augusta, Ga., merged with Graniteville Co. The seven mills have 164,020 spindles, 4023 looms and 5000 employes, who in 1945 produced 90,233,641 yards of cloth and dyed 86,739,773.

Production in an enterprise of this size requires a reliable source of process steam and electric power. Moreover, economy of operation dictates whether to generate or purchase electric power. So to meet the eventuality of installing generating equipment in the near future, the present boiler installation at Graniteville was designed for 500 psi and 750 F. A P Stevens, chief engineer, in charge of all company power facilities, acted as both consultant and designer for his new boiler plant, erected in 1945. The management named the new plant for Stevens, an unusual distinction, to say the least, because such an honor seldom goes to a man in the plant.

SIDEWALL LIGHTING

Looking ahead, Engineer Stevens erected a roomy building, made it easy to keep clean. Aluminum paint and sidewall floodlights provide good illumination. Spick-and-span is the only term that describes the plant; his housekeeping proves that coal can be unloaded outside the building, carried to overhead silos, and distributed to underfeed stokers without accumulations of coal dust streamlining the contour of every surface inside the plant.

Coal Handling. Coal comes to the plant by rail where it is unloaded to outside storage or into a vibrating hopper under the track. From the latter it goes by bucket elevator to either of two storage silos, each having 300 tons dead-storage and 50 tons live-storage capacity. Fuel in dead storage can be fed back to the elevator and transferred to live-storage space at the top. From here it flows by gravity to individual 200-lb vibrating scales before entering the nonsegregating chute supplying each unit, as shown in Fig. 1.

Boiler Arrangement. Steam is generated in two 500-psi 750-F 80,000-lb-per-hr 4-drum bent-tube duplex boilers equipped with furnace waterwalls. Units now operate at 200-psi saturated pressure. Firing is done by 9-retort link-grate underfeed stokers with 179.6-sq-ft projected-grate area.

A timing device on the stoker shaft controls the hydraulically operated link-grate section, which breaks up coking fuel and moves ash to the dump grate. Armor blocks protect against abrasion the waterwall tubes, along fuel-bed line, and bridgewall at ash-dump plate. Vertical extension of shiplap tile on top of bridgewall forms the first-pass baffle. Clearance between

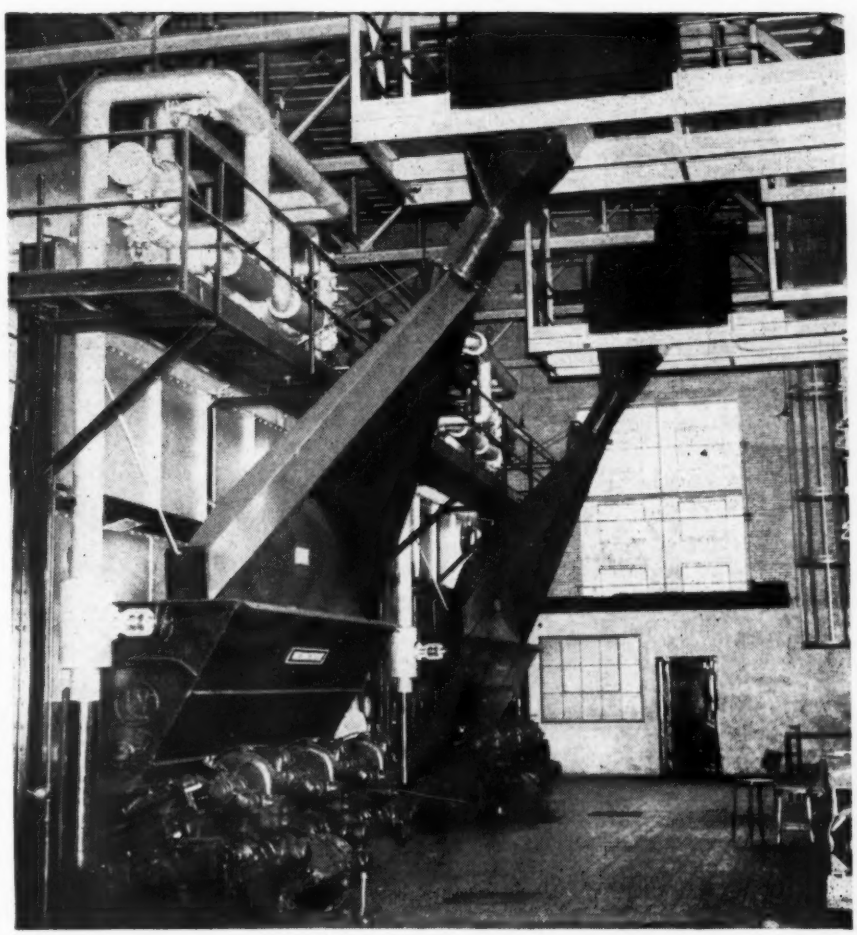


Fig. 1—Coal from outside silos passes over vibrating weigh scales before delivery to stoker. Combustion control regulates the stoker speed through the mg set

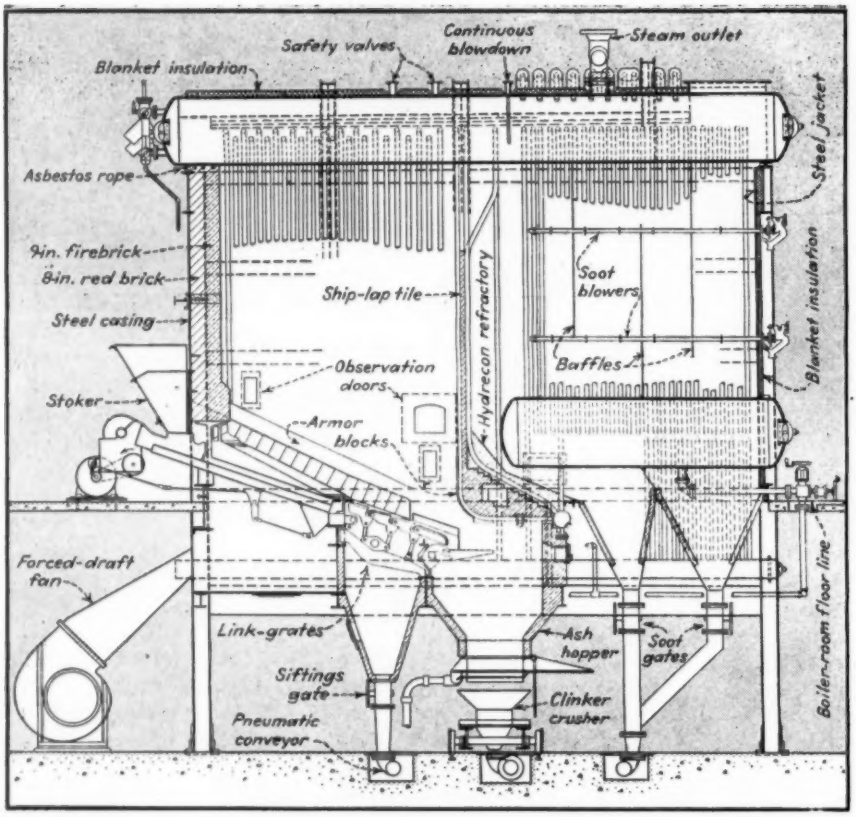


Fig. 2—Siftings and soot hoppers connect direct to the pneumatic ash-disposal system. The ashes go through a crusher before entering the disposal system

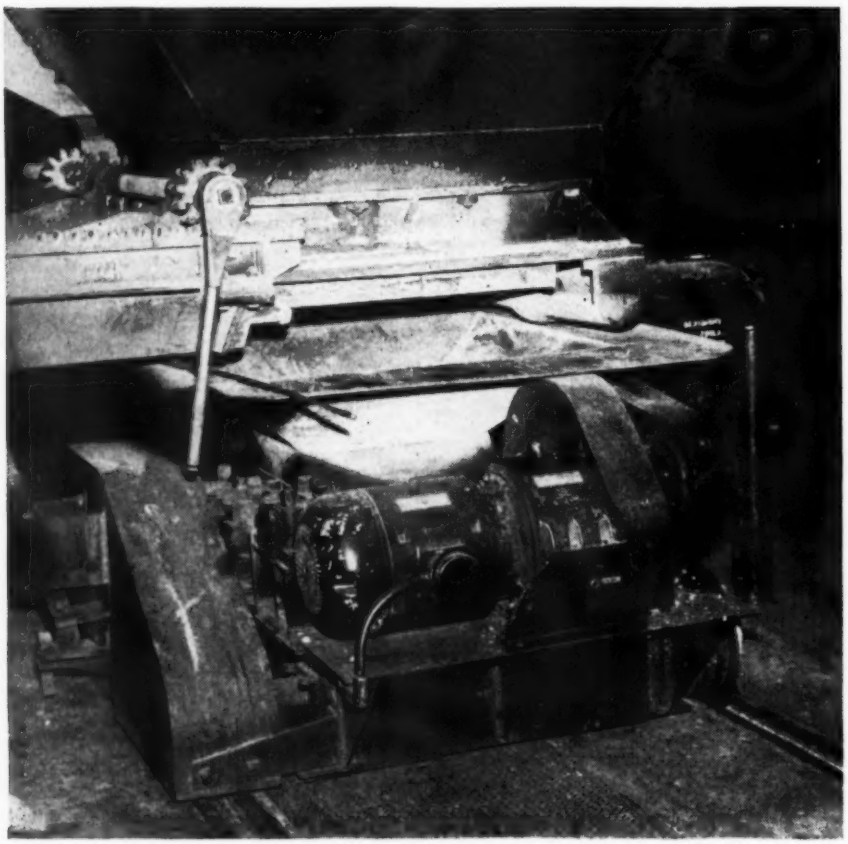


Fig. 3—Crusher travels under its own power from boiler to boiler as needed. Close clearance between it, ash hopper and disposal port eliminates any dust

boiler drums and refractory is sealed with 1-in. asbestos rope; casing joints get the same treatment and, in addition, a mixture of asbestos and fire clay to make them gastight, Fig. 2.

Space beneath each stoker is partitioned into two areas: one directly under the stoker tuyeres, another under the link-grate section. A damper in the partition facilitates manual adjustment of amount of air flowing into the link-grate area to meet the needs of glowing coke. Once this damper is adjusted air to both areas is regulated by the forced-draft damper.

Ash Handling. One siftings hopper, under the link-grate section of stoker, and two, under each of the two boiler passes, connect through individual rotary valves to the pneumatic ash-removal system. Ash collects in hoppers fitted with roller gates through which it can be discharged into a traveling crusher, Fig. 3, before entering the pneumatic conveyor. Latter transports it to a dustless silo outside the building. Backtracking from the silo, the discharge pipe connects to the steam-ejector venturi tube. Beyond this device the line divides into a crowfoot: straight branch going directly beneath the ash hoppers and left and right lines going to flyash and siftings hoppers respectively. Slide gates at crowfoot select the line to use.

First admitting steam to the ejector, flyash and siftings are removed by simply opening the rotary valves. For clinkers and ashes the inlet to the conveyor pipe is opened and the motor-propelled crusher positioned under the hopper. Opening the roller gate drops clinkers through the crusher into the conveying system. Slight negative pressure in furnace and suction of conveyor prevent dirt and dust scattering over the floor. A water spray at the conveyor discharge settles dust so the silo exhaust is clean. Moving from hopper to hopper the operator removes ashes quickly, without leaving a mess to clean up later. Steam used is 200 lb per ton of ash.

FIRING IS AUTOMATIC

Combustion control is effected by a steam-pressure-actuated master unit that varies stoker speed and induced draft-fan damper position on each boiler through a common shaft and reach-rod assembly equipped with manually adjustable cranks for load equalization. A furnace pressure-balance regulator controls forced-draft-fan damper. Forced-draft fan is turbine-driven and induced-draft fan uses a vertical steam engine. Reason for engine drive is that it permits a wider range of operating speeds. Stoker speed is varied by manipulating

a rheostat in the motor field of a mg set from which the stoker motor receives its power. One master regulator initiates load-change adjustments to both boilers operating in parallel.

For instance, if steam pressure falls, master regulator changes motor field-rheostat setting on stoker mg set and opens induced-draft-fan damper on both boilers for a higher combustion rate. The latter move upsets furnace pressure and the furnace-pressure regulator on each boiler opens the forced-draft damper for more air. Conditions stabilize at the new setting. Inspection of past load charts and log sheets revealed the interesting fact that variation in load balance between the two units stays within 1% of total load.

Engineer Stevens overcame expansion troubles between boiler and stack by fabricating a bellows expansion joint between induced-draft fan and stack base, Fig. 4. Thus no strain is imposed on the stack and boiler. Also the breeching is dust tight, a condition not found with the ordinary slip joint.

Average steam load of 110,000 lb per hr goes to supply heating, dyeing and slashing requirements. The boiler room treats each department as a separate customer, metering and billing steam on a monthly basis. Other flow-meters measure steam output from each boiler, steam to auxiliary units and total feedwater. Makeup averages about 90%, which is treated with caustic soda, sulphite and phosphate. A continuous blowdown and heat-exchanger system holds boiler concentration within recommended limits. All steam- and water-pipe joints are of welded construction. Piping and auxiliary units have capacity to carry a third boiler, which can be installed later in the present building.

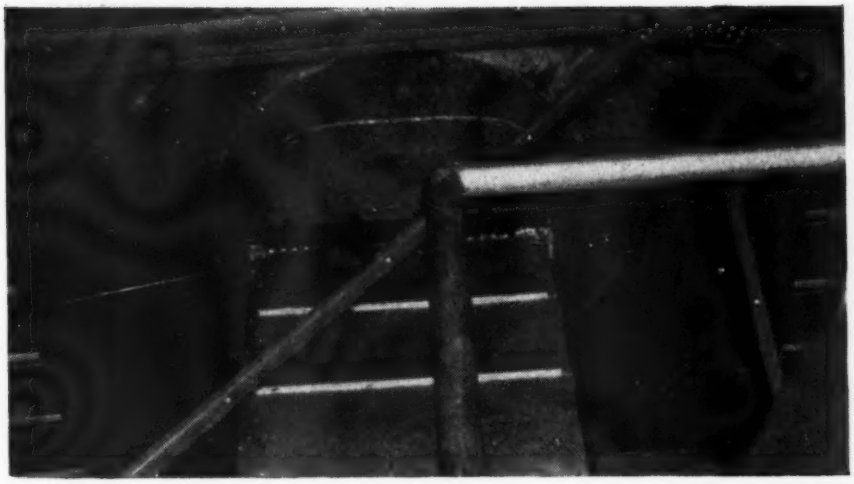


Fig. 4—Ingenious bellows-expansion joint between stack base and induced-fan uptake takes care of expansion and makes a tight, dustless seal at this point

PRINCIPAL NEW STEAM-GENERATING EQUIPMENT

Stevens Plant, Graniteville Co, Graniteville, S. C.

BOILERS AND AUXILIARIES:

Boilers, 2 ..... E Keeler Co
80,000 lb per hr, 500 psi, 750 F. 4 drums, bent-tube, duplex with furnace waterwalls. Now operate at 200 psi saturated.
Boiler refractory ..... A Lynn Thomas Co Inc
Boiler insulation ..... E Keeler Co
Water column ..... Reliance Gauge Column Co.
Soot blowers ..... E Keeler Co
Ash gates and soot valves ..... Beaumont-Birch Co.
Armor blocks ..... E Keeler Co

COMBUSTION EQUIPMENT:

Stokers (link-grate) ..... Westinghouse Electric Corp.
9-retort, 179.6 sq ft projected-grate area
Induced-draft fan ..... B F Sturtevant Co
Engine-drive ..... Troy Engine & Machine Co.
Forced-draft fan ..... B F Sturtevant Co
Turbine drive ..... Westinghouse Electric Co.
Oil pump for link-grate ..... Schutte & Koerting Co
Motor for oil pump, 0.75 hp, 1150 rpm ..... Westinghouse Electric Corp
Combustion control ..... A W Cash Co
Mg sets for stoker control (7.5 hp) ..... Westinghouse Electric Corp

VALVES, PIPING AND TRAPS:

Blowdown valves (tandem) ..... Yarnall-Waring Co
Safety valves (Consolidated) ..... Manning, Maxwell & Moore
Nonreturn valves ..... Lunkenheimer Co
Stop valves ..... Lunkenheimer Co
Traps ..... Strong Carlisle & Hammond Co
Piping ..... Grinnell Co
Pipe insulation ..... Starr Davis Co
Pipe hangers ..... Grinnell Co

FEEDWATER SYSTEM:

Feedwater chemists ..... Hall Laboratories Inc
Chemical pumps ..... Hills-McCanna Co
Deaerating heater, 200,000 lb per hr ..... Cochrane Corp
Heater-level indicator ..... Yarnall-Waring Co
Condensate pump ..... Goulds Pumps, Inc
60 gpm, 43-ft head
Condensate-pump motor ..... General Electric Co.
1.5 hp, 1730 rpm
Feedwater regulator ..... Stets Co
Boiler-feed-pump pressure regulator (Copes) ..... Northern Equipment Co
Boiler-feed pumps (2) ..... Allis-Chalmers Mfg Co and Goulds Pumps, Inc
(1) 400 gpm, 1390 ft head, 3550 rpm and (1) 400 gpm, 620 ft head, 2500 rpm
Boiler-feed-pump turbines ..... Elliott Co
215 hp, 425 psi, 3550 rpm
Continuous blowdown ..... Cochrane Corp
Flash tank, 50 psi ..... Cochrane Corp
Heat exchanger, 50 psi ..... Cochrane Corp
Feedwater makeup pumps ..... Allis-Chalmers Mfg Co
(2) 250 gpm and (1) 175 gpm, 110 ft head
High- and low-water alarm ..... Reliance Gauge Column Co

COAL AND ASH HANDLING:

Coal conveyors ..... Beaumont-Birch Co
Scales ..... Beaumont-Birch Co
Silo vibrator motor ..... Westinghouse Electric Corp
2 hp, 550 v
Coal-elevator motor ..... Westinghouse Electric Corp
7.5 hp, 550 v
Nonsegregating chutes ..... Stock Engineering Co
Clinker grinder ..... Beaumont-Birch Co
Grinder motor ..... Westinghouse Electric Corp
Pneumatic ash-and-soot removal ..... Beaumont-Birch Co
Steam ejector, 200 lb of steam per ton of ash

METERS:

Flowmeters ..... Bailey Meter Co
Air flow-steam flow ..... Bailey Meter Co
Pressure recorders ..... Bristol Co
Temperature recorders ..... Bailey Meter Co
Pressure Gages ..... Helicoid Gage Div. American Chain & Cable Co.

MISCELLANEOUS:

Roof-vent fan ..... The Louis Allis Co
Motor controllers ..... Westinghouse Electric Corp
Subway grating ..... Blaw-Knox Co
Distribution panel ..... Westinghouse Electric Corp
Office air conditioner ..... Creamer Martin Co
Stacks and breeching ..... J J Finnigan Co Inc
Structural steel ..... Southern Engineering Co
Building contractor ..... Daniel Construction Co
Construction superintendent ..... James G Gilbert
Electrical contractor ..... Carter Electric Co

Freeman H Dyke, left, assistant general manager, Wheeling Steel Corp, and AISE president; L R Milburn, electrical engineer of Great Lakes Steel Corp, president-elect, 1947

AISE Meeting Covers Wide Range in Engineers' Interests

On 4-day program are standardization of gear-tooth pressure angles; increased ratings of mill-type dc motors; high-pressure high-temperature steam plants; carbon-brush operation; spot conversion for dc motor drives

▶ THE ASSOCIATION of Iron and Steel Engineers held its annual 4-day convention and iron and steel exhibition from Oct 1 to 4, in Cleveland, Ohio, with headquarters in the Public Auditorium. Over 130 exhibits included a vast array of power and other equipment in the iron and steel industry, much of it arranged for operation. About 10,000 members and guests registered for the exhibition and the 13 technical sessions. Of 41 papers presented, those of greatest interest to power engineers are here digested.

Gear-Tooth Pressure Angles. L J Collins, General Electric Co, outlined factors for and against 14.5- and 20-deg pressure angles for gearing on steel-mill auxiliaries and cranes, with the object of standardizing either one. He attacked the problem as an engineer required to design a gear train for a specific application, giving reasons for choice of design factors. Although the 20-deg pressure-angle gear was favored for the greater strength of its teeth and other reasons, discussion indicated wide diversity of opinion. However, much of the lack of agreement resulted from conditions under which gears operate. Experience favored the 20-deg pressure-angle gear.

Mill-Type Dc Motors. Electric-motor manufacturers have proposed that mill-type motor ratings be stepped up one size to take advantage of improved design and materials. This rating change requires that the present 5-hp frame, with new motor built in, have a 7.5-hp rating, and the old 7.5-hp frame, 10-hp rating. At the other end of the scale the 150-hp frame will be good for 200 hp. A new 5-hp design is to be developed in a smaller frame than the present 5-hp design.

F W Cramer, electrical engineer, Carnegie-Illinois Steel Corp, presented results of a study to determine steel-mill engineers' opinion on the above proposed change in mill-motor ratings. This study was based on a questionnaire sent to steel-mill engineers. Answers favored the new ratings, but much more study of the change is needed before the steel industry will be ready to accept the new standard.

Steel-Mill Power Generation. F A Sawyer, Stone & Webster Engrg Corp, discussed economic advantages to be gained by using, in steel-mill power-generating plants, pressures and temperatures comparable with those in the most efficient public-utility central station. For many years public utility engineers have accepted high pressures and temperatures as the answer to maximum economy in steam-plant design and operation, but many steel-plant engineers hesitate to take advantage of these possibilities.

Only eight steel-mill power plants operate above 500 psi. One, Weirton Steel Co, has three 400,000-lb-per-hr boilers at 850 psi and 800 F, and two 10,000-kw turbines. J H Strassburger told how these boilers, with 100% makeup feedwater, have average availability of nearly 95%, and the turbines, 98%.

When put in service a boiler operates 90 days continuously, then is shut down four days. Most of this time is needed for work outside the boiler rather than inside. Conditions under which this plant operates show that modern high-pressure high-temperature plants, when properly designed, can handle the severest steel-mill loads at high efficiency and maximum reliability.

Carbon-Brush Operation. On sliprings and commutators such operation is usually supposed to be well understood. However, the paper *Modern Trends in Brush Operation*, by Leon D Cook, Commonwealth Edison Co, and the discussion of it, showed quite the reverse. Mr Cook outlined brush-operation trends and latest theories in relation to current flow through moving contacts.

Outside of having brushes correctly beveled, it was suggested not to fit them to the commutator with sandpaper because they only make contact at a few points, no matter how carefully they are fitted. Consequently, brushes not fitted to commutator or sliprings operate as well as those given the most accurate fit.

Formation of a film on sliprings or commutators, thickness of this film and how best to maintain it, current distribution between different brushes in a group, and factors that influence this distribution, effects of humidity on commutation and brush wear, cleaner brushes, how and when to use them, grooving of sliprings and commutators, proper methods of undercutting commutators, and other brush-operation factors called forth a wide range of engineering opinions.

Ac-to-Dc Spot Conversion. The paper, *Spot Conversion for Adjustable Speed*, by R A Geuder and W R Hough,

(*Continued on page* 152)

THE OPERATING ENGINEER

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS—ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

Beware of Boiler-Water Level: It May Play You False

Since operators are inclined to put too much faith in gage-glass readings, low-water level is still a common cause of serious boiler damage. To emphasize the need of making sure the gage glass indicates true water level, Harry M Spring tells how to detect 16 causes of false boiler-water level

► DESPITE EDUCATIONAL BULLETINS, engineers' and firemen's license examinations, and many safety articles published for the operating engineer, accidents from low water in boilers continue. Because many are due to blind faith in water level shown by the gage glass, 16 different conditions are here given that can cause the gage glass to indicate a false reading, along with approved methods for detecting the fault.

1. *Install Water Column Correctly.* When installing a boiler, it is important to know the lowest safe water level permitted. A straight edge and a level make it simple to check water-column elevation so that the lowest visible part of the gage glass is above the lowest safe water level, Fig. 1.

An alternate method of checking water-column elevation is to leave the manhole plate out of the shell's top or steam-drum end and open the feed-water valve to fill the boiler. Close the valve when water first shows in the bottom of the gage glass. Water level in the boiler can then be determined by reaching through the manhole with a 6-ft. rule.

When fusible plugs were installed in practically all steam boilers, they were located at the lowest safe water level. The water column was then installed so that the lowest visible part of the gage glass was at least one inch above the fusible plug. Whether such a plug is used or not, it is good practice to have a safety margin of one inch or more between the gage glass' bottom and the lowest safe water level. The lowest water level that is permissible for several common types of boilers is as follows:

A. Hrt boilers: highest part of the top row of tubes.

B. Locomotive-type boilers: 1 in. above the highest part of the crown sheet.

C. Vertical boilers: not less than one third of the distance up the tubes above the lower tube sheet.

D. Cross-drum or longitudinal-drum watertube boilers: 6 in. above the bottom of the steam drum in straight-

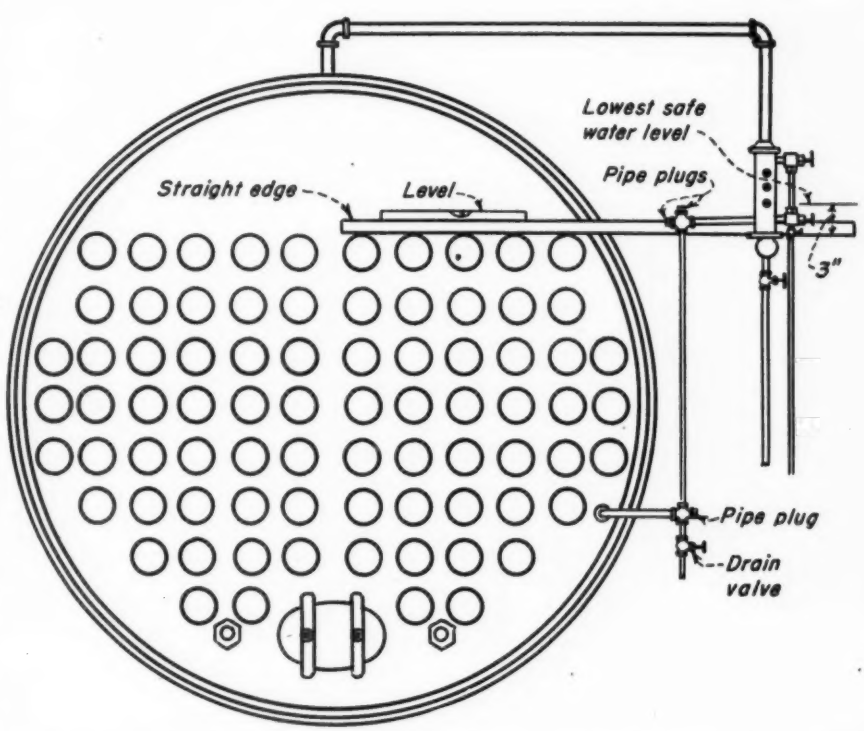


Fig. 1—Straight edge and level provide a simple means of checking gage glass to determine whether its lowest visible part is above lowest safe water level

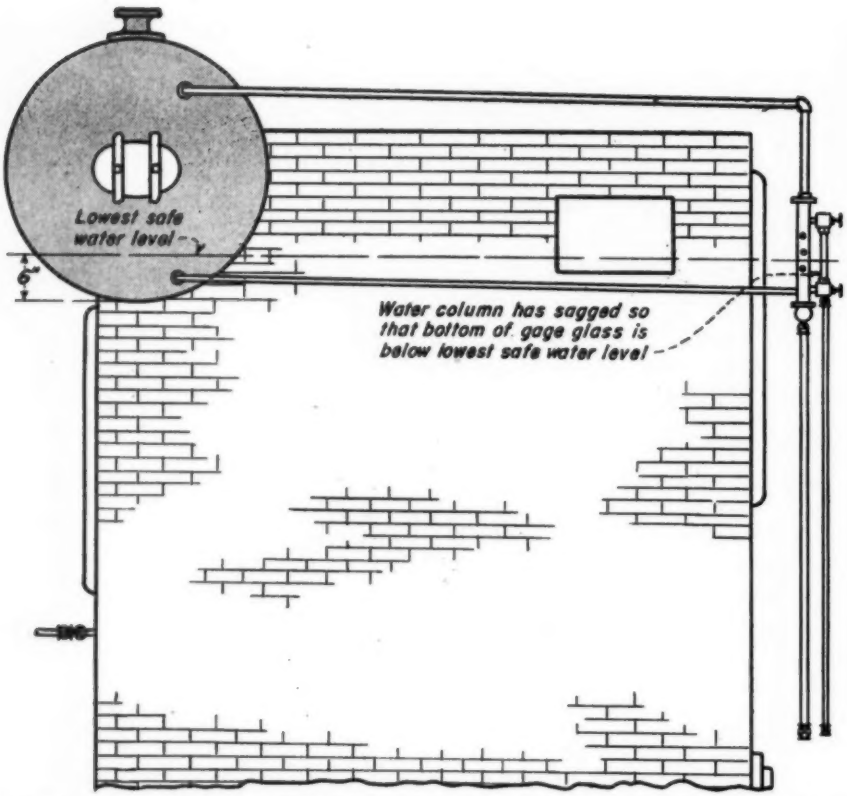


Fig. 2—Water column, sagged as shown, traps water in column and gage glass so the glass shows a safe water level even though it may be dangerously low

tube types. Three- or 4-drum bent-tube boilers, with the steam drums on the same level: 6 in. above the bottom of the steam drum.

E. Scotch marine boilers: 1 in. above the highest part of the crownsheet.

F. Scotch dryback boilers: highest part of the top row of tubes.

2. *Settling of a Boiler.* Settling is a common fault especially if the foundation is on filled-in land. Buckling of brick supporting walls or of steel support columns is another cause for a boiler settling. Steel columns embedded in brick walls may corrode or burn to the point of failure.

Because a boiler may settle unevenly the water-column end may go too low. Fig. 3 shows the effect on water level when an hrt boiler's front end settles several inches. Even though water shows in the gage glass, the rear ends of the top row of tubes are uncovered. Exposure of these ends to the hot gas causes severe leakage, which may lead to discovery of the settling. Settling also causes severe stressing of steam lines and other piping.

3. *Water-Column Settles.* Inadequate supports for the water column and piping sometimes causes a column to settle. A water-column assembly frequently weighs 50 lb or more, and if installed at the ends of long pipe-lines, suitable anchors or brackets must be provided. Fig. 2 shows the water column has sagged in a way that traps water in it and the gage glass even though boiler-water level has become dangerously low.

A sagged water column is easily revealed by sighting along the pipe connections or, if necessary, by using a straight edge and a level. If the gage-glass drain valve is opened for a short time and closed, the water column may hold enough water to fill the glass to a slightly lower level. If, however, the water-column drain is blown down when water is low in the boiler, water will not return to the column or gage glass, thus giving a warning signal.

4. *Lower Water-Column Connection.* Many boilers have been damaged or ruined by obstructed water-column piping. At best, circulation in this pipe is sluggish, and it is an ideal spot for sludge and loose scale to settle. Accumulations may completely block the line, Fig. 4.

If the lower connection to the column is obstructed, water cannot enter from the boiler, but neither can water from the gage glass or water column drain out. Water trapped in the gage glass and water column remains even though the water level in the boiler goes far below the lowest safe level. Because of steam condensation in the water column and gage glass, water level shown by the glass and trycocks gradually rises. To prevent obstructions, the ASME Code specifies a minimum of 1-in. pipe for water-column connections.

OBSTRUCTION REVEALED

An obstruction in the lower connections to the water column is revealed by blowing down the glass and the column. If the drain valve is opened for a short time and closed, water returns to a slightly lower level in the gage glass because of the water column's reservoir capacity. When the column is blown down, however, water will not return to it or the glass. The empty water column is shown by steam blowing from all three trycocks when they are tested.

5. *The Lower Water-Column Valve Closed.* Shutoff valves are sometimes installed in water-column connections. If the valve in the lower connection is closed, accidentally or otherwise, the effect is the same as with an obstruction

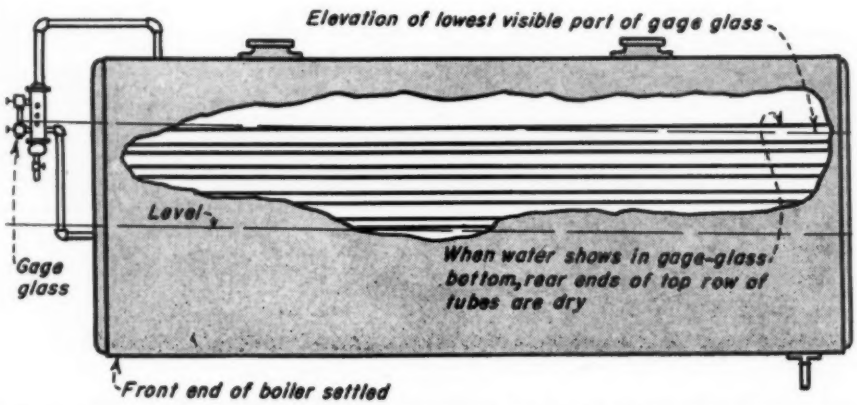

Elevation of lowest visible part of gage glass
Level
Gage glass
When water shows in gage-glass bottom, rear ends of top row of tubes are dry
Front end of boiler settled

Fig. 3—When front-end of hrt boiler settles, the gage glass may show water level at a safe elevation when the tubes' rear ends are dangerously exposed

in the pipe, mentioned in 4. Boiler laws in most states require that where shutoff valves are used they must be of the outside screw and rising-stem gate type. The stems are easily observed and show at a glance whether the valve is open or closed. It is also a general requirement that the valve be locked or sealed in its wide-open position.

BLOCKED CONNECTION

6. *Upper Water-Column Connections.* Since the upper connection to the water column is normally above the water level, it is not subject to scale and sludge deposits as is the lower one. An obstruction in the upper connection rarely occurs, but it may if the steam foams considerably because of high concentration of solids within the boiler. If the upper connection to the water column is blocked so boiler pressure cannot act on top of the water in the gage glass and water column, both will fill with water and remain that way as long as boiler-water level is above the lower connection to the column.

7. *The Upper Water-Column Valve Closed.* A closed shutoff valve in the upper connection gives the same results as the obstruction mentioned in 6. If a shutoff valve is used, it must be of the outside screw and rising stem type, locked or sealed open to prevent its being closed accidentally.

8. *Lower Connection to Gage Glass.* An obstructed gage-glass connection will trap water in the glass regardless of the water level in the water column or boiler, and condensation will gradually fill the glass. When the lower connection is obstructed, water will not return to the glass after it is blown down. If water level in the boiler is within the water-column range, the try-cocks when opened will show it.

GAGE GLASS SHUTOFF

9. *Closed Valve at Gage-Glass Bottom.* Here again, a closed valve brings the same results as an obstruction, see 8. Water will be trapped in the glass to rise slowly as steam condenses, regardless of water level in column or boiler. There is no excuse for the extreme carelessness of not knowing that a gage glass is shut off, but accidents from this cause still occur with disastrous consequences.

10. *Upper Connection to Gage Glass.* As with the upper connection to the water column, obstruction by scale or sludge is remote. However, there is the possibility of foam deposits or of pieces of gage-glass packing lodging here. If this occurs and steam is blocked from the top of the gage glass, water level in the glass fills rapidly regardless of level in the column or boiler, provided the lower connection is clear and below water level.

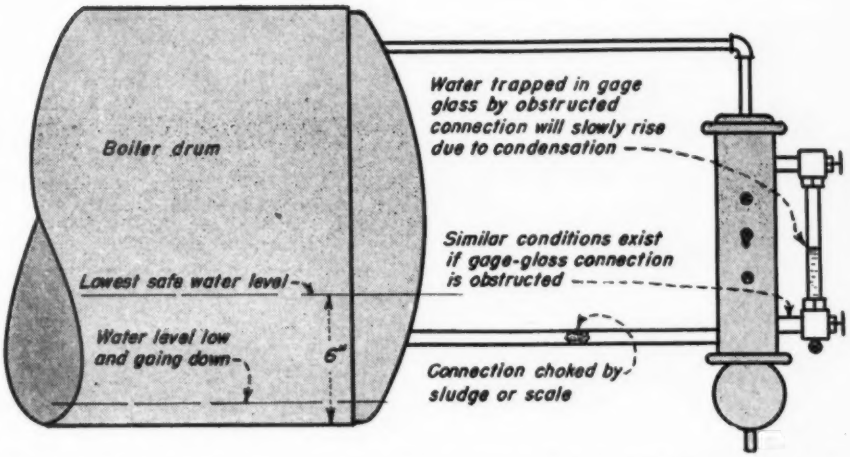

Boiler drum
Water trapped in gage glass by obstructed connection will slowly rise due to condensation
Similar conditions exist if gage-glass connection is obstructed
Lowest safe water level
Water level low and going down
6"
Connection choked by sludge or scale

Fig. 4—Water circulation is slow in lower connection to water column. It is an ideal place for sludge and scale to lodge until pipe is completely blocked

11. *Closed Valve at Top of Gage Glass.* The outcome will be the same as with the obstruction in 10, and is the result of carelessness by the boiler operator no less than operation with the lower connection shut off.

12. *Leaks Through a Gage Glass.* Steam blowing from a crack or defective packing in the upper part of a gage glass reduces the pressure slightly and causes a false high-water level in the glass. If the leak is below water level, water in the glass may stand lower than it is in the boiler.

13. *Improper Water-Column Connections.* Limit connections to a water column or its piping to those in which there is no appreciable flow. Permissible connections include those for the pressure gage, float chamber or expansion tube of a feedwater regulator or low-water cutout, damper-regulator diaphragm and combustion-control diaphragm. The only connections through which there is flow should be the drain lines and low-high water-alarm whistle.

A tap off the water-column steam connection for washrooms, injectors, soot blowers or other such purposes is dangerous. It may cause the gage glass to show a much higher level than in the boiler. It is likewise dangerous to tap off the water connection to a water column. Not only may a false low-water level be shown, but boiler water may be drawn off without the fireman's knowledge.

14. *Leak in Water-Column Steam Piping.* Blowing steam from the water-column piping may cause a false high level in the gage glass. If the leak is above the boiler a further hazard exists in the condensation that may drip on the boiler shell to corrode the plates.

15. *Effects of Diaphragm Failure.* If the steam connection to a water column supplies the diaphragm chamber of a damper regulator or combustion-control device, put a shutoff valve in the diaphragm pipe. Shut off this line at once if the diaphragm fails because steam flow will cause a false high-water level in the glass.

16. *Wrong Pitch in Water-Column Pipes.* Arrange these pipes so that the steam line pitches slightly towards the water column with no sags or pockets for condensate. Pitch the water connection towards the boiler so water will not trap in the column on a receding level. Provide any necessary bends that might form pockets with at least ¾-in. drains controlled by rising-stem gate valves.

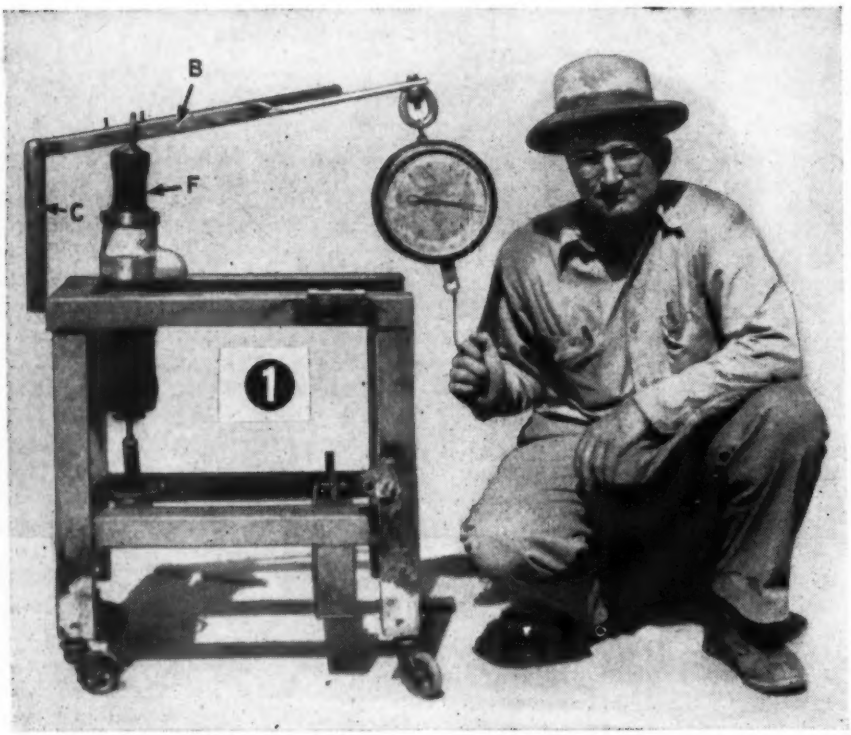
CARELESS OPERATION

Reference has been made to carelessness of some boiler operators. Two incidents occurring within the past few months serve to illustrate extreme incompetence. In each case, water was low in the glass and the low-water alarm whistle was blowing. But the fireman, annoyed by the noise, gagged the whistle and went about his duties without further attention to the boiler. It was badly damaged because of low water.

Possibly employers have been reluctant to let a man go for any cause because competent help has been so scarce during war times. Some firemen and boiler operators have taken advantage of this to grow careless in the performance of their duties. It would seem the day is about here when an incompetent, lax person has no place in the operation of a steam boiler plant.

PRACTICAL AIDS TO OPERATION

Plant-Tested Methods and Ideas for Power Men



TEST STAND FOR GAS-ENGINE VALVES

AT ONE TIME we tested our gas-engine valve springs with a lever and small platform scale, but this did not prove as satisfactory as we would have liked. Experience showed that a spring, which tested satisfactorily by this method, did not necessarily mean correct operation in the valve cage. One reason is that as valve and cage wear in service, space in which the spring is confined lengthens and spring tension decreases.

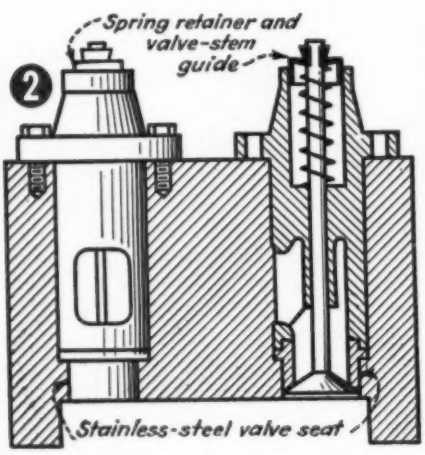
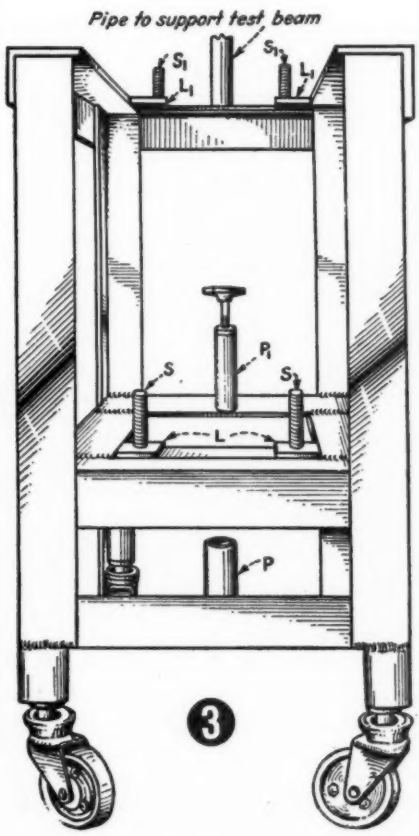


Fig. 2 shows a cross-section through one of the valves in our engines. To provide for spring testing of individual valves under installed conditions we built the stand in Fig. 3. Built of sections of 2x2½-in. angle iron welded together, the stand is supported on casters for easy moving from place to place. Two lugs, L, welded to the bottom part of the frame have two vertical studs, S, welded to them for positioning an inverted valve cage. In this position the valve stem rests on a spring in a section of 1-in. pipe P. The spring lifts the valve about ½-in. off its seat. For light seating the valve is easily pressed against the grinding compound on the seat and turned with the palm of the hand.

Two horizontal lugs, L_1, welded to the stand's top have each a stud S_1 to position the valve cage for spring testing. A section of ¾-in. pipe, P_1, has a ½-in. nut welded to its top. A bolt with a flat welded-on hexagonal head threads into the nut. This screw is run up against a valve to prevent it falling out of its cage after the keeper has been removed from the valve stem.

One of the chief purposes of studs S_1 is to support the valve cage while the valve spring is being tested, as in Fig. 1. The test beam B hinges in a pipe column, C, at the back of the stand. A fitting, F, that rests on the valve stem's top connects to the beam by a loop between two pins and this forms a loose connection. A postal-type scale connects to the free end of the beam. With the valve in position as shown, we pull down on the scale until the valve is lifted from its seat.

To make the test we leave the valve-



cage assembly as it comes from the engine and check the valve for opening pressure required just to lift it off its seat. In this way spring tension is determined under operating conditions except for temperature. Experience has taught us the proper spring tension for best operation. When necessary we use washers in the bottom of the spring well to compensate for wear and give correct spring tension.

This stand, which is 24-in. deep, 14 in. wide, and 26 in. high, has proved useful when working on the valves. It not only supports them for spring testing, but also when taking them apart and reassembling.

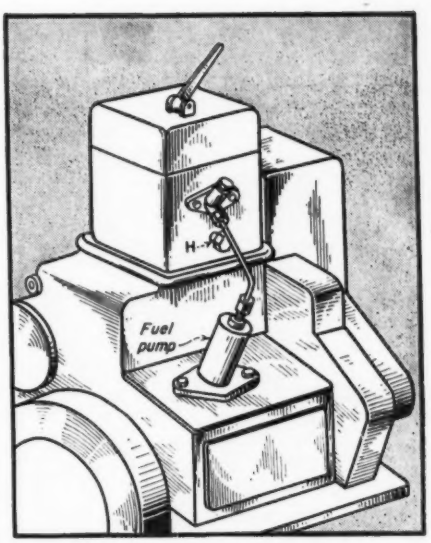
Shiprock, N. M. JAMES F MAHER

Lube-Oil Shot Makes Engine Start Easily

ON BOARD SHIP OUR auxiliary bilge pump, generator and air compressor were driven by a one-cylinder 4-cycle diesel engine with compression release for hand starting, as in the figure. As the engine wore it became harder to start when cold. It had a combustion-chamber plug to hold punk for cold-weather starting. Fuel oil from the nozzle usually extinguished the punk before the engine could be brought to sufficient speed to apply compression, but we found a way to start it when cold.

We remove the plug punk holder, *H*, and with a hand oiler shoot three or four good squirts of SAE No. 20 diesel lube oil into the combustion chamber. We replace the plug and use normal starting procedure. This never fails to start the engine on the first try, even in severest weather. Determine by trial the amount of lube oil. It seals worn valves and piston rings and raises the compression ratio. This offsets heat loss from the compressed air to the cold cylinder walls and gives a final compression temperature high enough to ignite the fuel.

This may seem severe treatment for an engine, but it was justified in our



case. The starting method did not seriously affect the engine during the five years that I have knowledge of its operation.

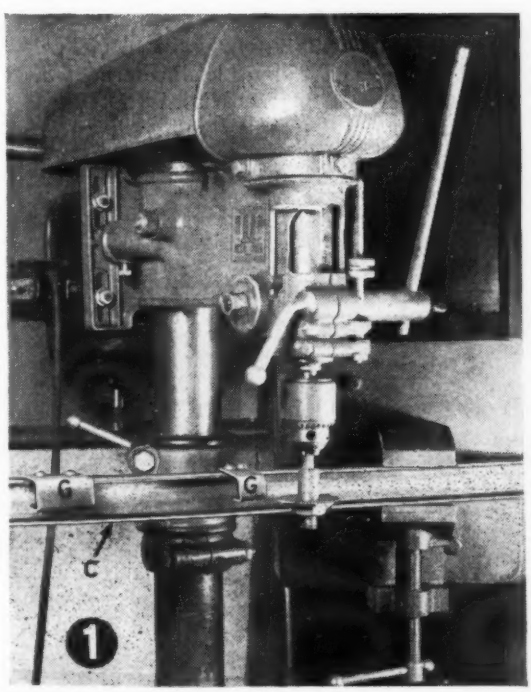
DEAN H BERGMAN
Bellingham, Wash.

DRILL-PRESS JIG FOR SPLITTING CONDENSER TUBES

USUALLY when condenser-tube trouble develops, the first job in locating the cause is to split the defective tubes. Doing this by hand is slow work and often produces a ragged cut. We made a jig, which eliminates all these objections, for use in a drill press.

We cut this jig from a section of 1½-in. channel iron, *C*, about 8 ft long, which nicely accommodates a condenser tube between its sides, Fig. 1. Two guides, *G*, were made of metal of the same thickness as the saw cut. These guides fasten to the top side of the jig and have a span that reaches into the saw cut when the tube rests on the jig's bottom side for cutting, as in Fig. 2.

We also made a spindle on which the saw could be secured in the drill-press chuck. To protect the operator from flying chips we attached a sheet-metal guard, not shown, to the drill-press frame, using the spindle locknut as the holding medium. The saw, a



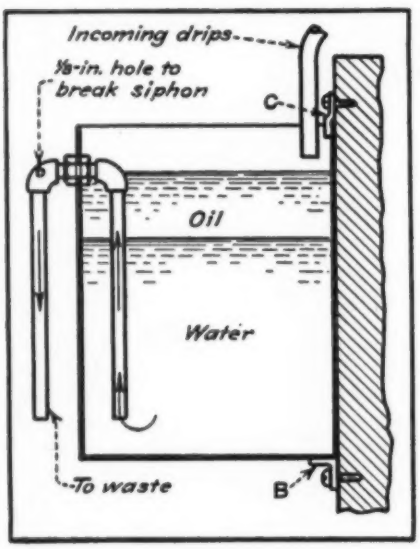
high-speed fine-toothed one, 2¼-in. in diameter, is 0.57 in. thick.

After the equipment has been assembled and the saw is running, the condenser tube is placed in the channel-iron jig and slowly pushed ahead until it engages the saw. When the tube's end passes the saw a short distance, guides *G* enter the cut to prevent the tube from turning. When split on one side, the tube is turned 180 deg and its opposite side split.

Sea Cliff, N. Y. AVERY PATERSON

Siphon Improves Drip Collection

DRIPS FROM AROUND our engine's piston packing contained considerable oil that we recovered by draining to a container

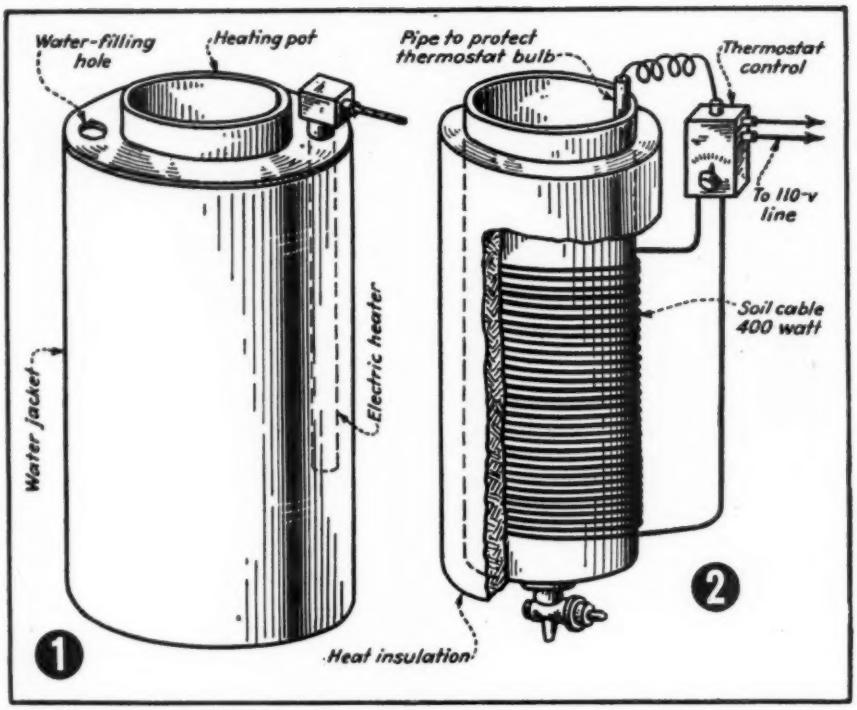


and then emptying into the centrifuge. To eliminate much of the water in the oil and at the same time reduce the attention these drips required, I installed an overflow in container as in the diagram.

The overflow consists of a length of ½-in. pipe that extends down inside the container to a point near its bottom. This and a similar length connect to a short pipe nipple through a hole near the container's top. As indicated, water settles to the bottom and goes up the overflow to waste while the oil remains in the container. After installing the water overflow, the container required emptying only about every two weeks. To prevent emptying the container because the overflow acted like a siphon we drilled a ⅛-in. hole in the outside elbow, as indicated.

The container set on an angle-iron bracket, *B*, on the engine frame and was held in place by a clip, *C*. Loosening this clip permitted ready removal of the container for emptying.

Flushing, N. Y. S M ELONKA



ELECTRIC HEAT CUTS HEATER TROUBLES

GLUE POTS IN OUR PLANT were water heated, as in Fig. 1. Jackets surrounding the pots were filled with water and heated by immersion electric heaters, water temperature being controlled by thermostats. These pots gave a lot of trouble. A funnel was used to fill them with water, which the operators frequently spilled on the floor. The water sometimes forgotten in the pots, evaporated to a low level and exposed the heaters, which overheated. Then when the jackets were filled, sudden contraction caused the heaters to crack.

To eliminate this trouble I arranged to heat the pots directly by electrical-heating coils. I made new pots from 18-in. sections of 6-in. pipe and wound 60 ft of soil cable around each one. Over the soil cable I placed a section of 6-in. (pipe size) 85%-magnesia heat insulation. The soil cable was connected through a thermostat control to a 110-v line.

To protect the thermostat bulbs I put them inside sections of ½-in. pipe in the glue pots. These pipes were left open at the bottom end and had holes bored through their sides to permit free circulation of the glue. This arrangement has eliminated all our trouble with the watercooled pots and gives the more uniform glue temperature of 180 F.

Incidentally soil cable has an alloy resistance conductor with a resistance of 0.5 ohm per ft, insulated with felted asbestos with a lead covering. Sixty feet is the recommended length for 120-v, and 120 ft for 220-v. I have found it the solution to several low-temperature heating problems.

Englewood, N. J. R BOETTINGER

Installation of Cast-Iron Steam Boilers

NO AMOUNT OF CARE in operation or maintenance overcomes difficulties resulting from improper installation. The following pointers serve as a guide to engineers when a boiler is installed.

1. Select a boiler of proper size to supply at its outlets total heat required under operating conditions stated in specifications covering the installation. If possible, an experienced heating engineer, in co-operation with the boiler manufacturer, should write these specifications. Otherwise, impaired operating efficiency or damage may result.

2. Select a boiler designed to burn the available fuel. General design and furnace proportions may be intended for

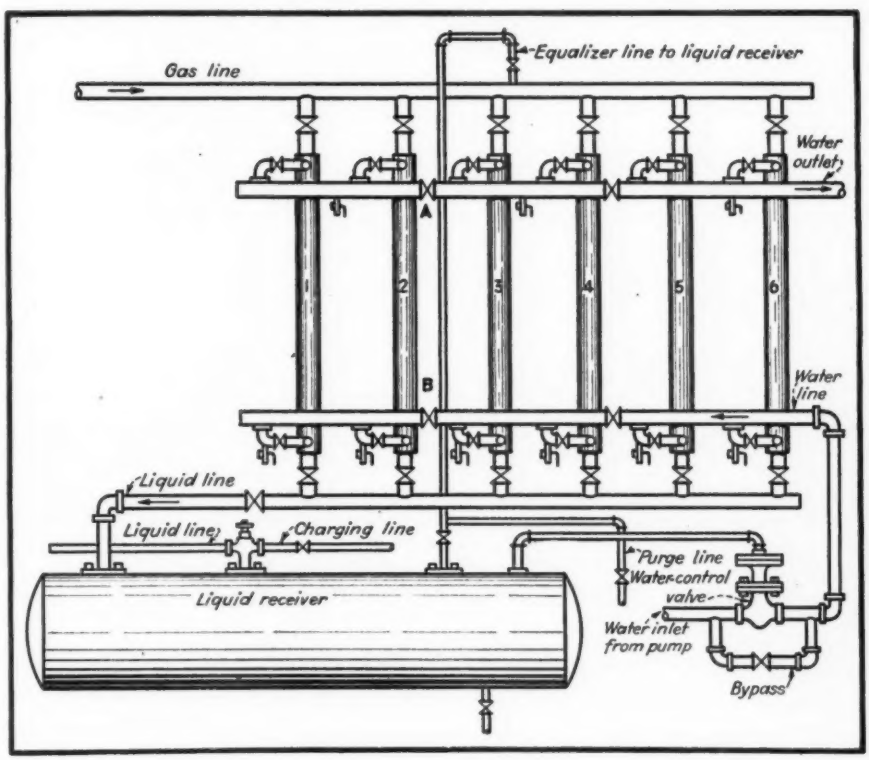
a certain fuel and may not give best results with others.

3. Have the boiler installed under competent supervision, if possible under the direction of the manufacturer's representative. If this cannot be done, select the most experienced workmen available.

4. Select a full complement of good appliances. Essential appliances are: 15-psi safety valve of proper size; pressure gage and siphon; gage glass; at least two gage cocks at the proper level; feed valve; blowdown valve; check valve or Hartford loop in the return lines if there is a stop valve in the steam line. Other desirable appliances include a feedwater regulator for coal-fired boilers or those not receiving all returns by gravity, a feedwater regulator or low-water cutoff in oil- or gas-fired boilers, a damper or combustion regulator with a shutoff valve, a test connection on the pressure-gage line, and a check valve in the feed line. Appliances should always comply with local laws.

5. Have boiler inspected before firing. Some localities require a hydrostatic test and certificate to operate. In any case, it is usually advisable to have installation inspected. Errors may be disclosed whose correction may prevent damage or future operating difficulties.

Canton, Mass. HARRY M SPRING



REDUCED CONDENSER AREA AVERTS FREEZING

OUR DOUBLE-TUBE ammonia condensers are on the plant roof in an exposed location. As a result, in winter when our refrigeration load is light it is difficult at times to keep the condenser pressure high enough for stable control of the expansion valves. Reducing water flow to a minimum by automatic water-control valve is dangerous. Water from the circulating pump divides to six condenser stacks, as in the diagram. Under minimum flow conditions circulating water flow is so low that water froze in some end-return elbows and cracked them on several occasions.

To remedy this condition we reduced the condenser cooling surface by closing valves *A* and *B* to cutout stacks 1 and 2, and drained the water from them. We left the ammonia lines connected in these stacks so they acted as air-cooled condensers. We found that cutting out two of the six stacks was sufficient to keep the condenser pressure normal, and more water was handled by the automatic-condenser-water valve.

This prevented water freezing in the condenser connections during plant operation. When the plant is not operating the condenser drains back to the reservoir through the pump, which does not have a foot valve. To insure draining of the condensers and prevent freezing of water lines when the pump stops, check valves have been omitted from its suction and discharges.

Ottawa, Ont. JOSEPH BONGIORNO

Free-Swinging Hitch Aids Shifting of Welding Unit

TO FACILITATE moving his welding-unit cart around the shop and over a roadway connecting different plant buildings, a welder modified the cart handles to permit towing by a service truck, as in the photo. At the center of the 1-in. handle crossbar he placed a 1½-in. pipe nipple, *N*, and on either side of it spotwelded a ring to the bar. These rings fixed the nipple in place, but left it free to rotate on the crossbar. To nipple *N* he welded a 6-in. section of 1½-in. pipe, *M*. To this are attached a fork and trailer-hitch ring, *R*, the latter being free to swing in a lateral plane around the crossbar.

This free-swinging hitch provides a quick, easy means of attaching the welding cart to any vehicle that might

be driven to the job. Because the hitch, when free, always swings down to a vertical position it does not interfere with normal handling of the cart in the shop. A single steel band, formed to fit around the gas bottles, swings on a heavy hinge at one end and latches closed in a hasp at the other to secure the bottles to the cart.

Pomona, Calif. G M WILSON

READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

1—How Is Slag Avoided On Superheater Tubes?

WE HAVE FIVE 48,000 lb.per-hr Sterling type boilers. Superheater tubes are located as in sketch *Q*-1, opposite page.

These Sterling-type boilers are fired with blast-furnace gas. The dust content varies from 0.7 to 2.0 grains per cu ft. Superheaters are continually stopping flue-gas passage because dirt and slag collect between the tubes. There are two rows of tubes with both headers at the bottom. Gas passes through four rows of tubes, which are staggered so there is no direct passage through them.

Present soot blowers are located at points designated by *o*, and the arc through which they blow is indicated by arrows. Proposed new soot blowers are designated by *x*'s. Blower between superheater tubes would have to be retractable because there is no means of supporting it. Superheater tubes are about 18 ft from bottom drum to top of bend. Heavy lines are baffles. Arrows mark path of gas. Can POWER readers suggest a better way to remove or prevent this accumulation of dirt and slag?—LBW

2—What Is Easy Way to Defrost Cooling Coils?

IN OUR MEAT-PACKING PLANT defrosting cooling coils causes much unpleasant labor. We have several Gebhart fin-type forced-circulation cooling units to assist the stands of pipe in the various large room-size boxes. All are kept at 38 F except one, which is connected to a separate 15-ton machine. This one is held to a temperature of not more than 8 F. All machines use ammonia.

Frosting blocks off the air space completely within two or three days, and the forced-air circulation between the fins stops. In the freezing room this condition is so bad that we have to defrost every day.

In cooling rooms we simply shut off cooling units until they defrost, and catch the devil when the box temperature goes too high and thus spoils the food.

In freezing room we shut off refrigerator and spray hot water on finned unit. This is the worst job imaginable. Nozzles freeze, melted ice refreezes, and room temperature goes up.

The management will not install lines to circulate hot gas for defrosting. What can we do to improve our present procedure?—HHD

Editor's Note: *Every month several good answers cannot be published because they arrive too late to meet the deadline.*

Give your answer a chance; be prompt with your reply. All answers that reach us before the 22nd of November will receive consideration for the next issue. Let yours be among them.

Answers to September Questions

Why Do Rotor Bars Break in 30-Hp Motor?

(This is Question 1 from the September issue, with best answers from readers)

WE HAVE *a motor-driven coal-loading machine that walks around on caterpillar tracks. We use it out in the storage yard to load and handle coal that is stored or moved into the plant. The loader is driven by a 30-hp 3-phase 440-v squirrel-cage induction motor. Load on the machine varies considerably when it operates because it slows down and speeds up as it bites into the coal pile.*

About six months ago the motor started giving trouble so we removed it for investigation. Our inspection revealed that several of the bars through the rotor slots were broken. After these were replaced the machine was put back in service. In about two weeks the same condition was again observed and as before several rotor bars were broken. The motor, which has just been repaired for the third time, reveals several new bars broken as well as some additional old rotor bars.

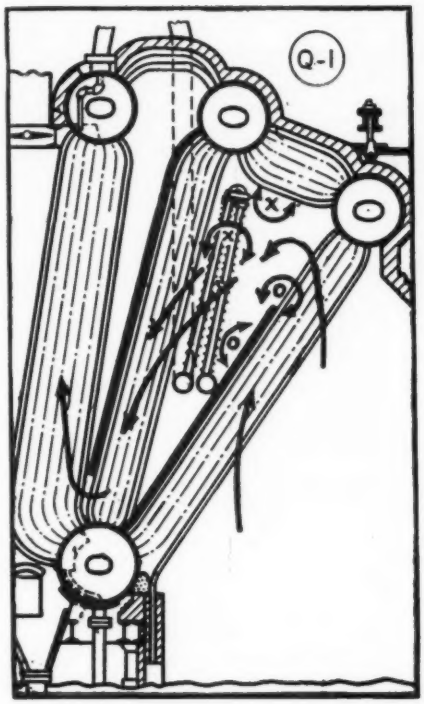
We want to find out what is causing this trouble. Will POWER *readers tell us what is breaking the rotor bars? What can we do to correct this troublesome maintenance problem, and why did the motor operate several years without acting up?—FLB*

New Cast-Aluminum Rotor

ROTOR BARS of an induction motor, under conditions *FLB* describes, take a terrific beating from thermal expansion and contraction. Copper rotor bars of an induction motor, operated under almost stalled conditions, carry 250 to 300% normal full-load rotor current. Since rotor heat is a square function of rotor current, repeated pulling down of motor speed by the load causes the hard-drawn copper bars to expand and contract in the rotor slots. Short-circuiting end rings tend to restrict expansion and contraction because of greater strength.

Expansion and contraction forces aided by any severe vibration eventually cause the copper bars to break at the first weak spot that develops. Usually such a spot is a high-resistance joint or connection. Since the copper bars in this rotor are failing in so many instances, it is best to replace all bars and the shorting rings.

A solution for a 10-hp saw-arbor motor operating under similar conditions in our shop, with a copper-bar squirrel-cage rotor, was to use a new cast-aluminum rotor. This type rotor may not be available in the 30-hp



size. Since aluminum has a higher specific resistance than copper, rotor slots must be larger, and this necessitates an entirely new rotor. The cast-aluminum process produces a uniform-conductivity rotor.

Valley Stream, N. Y. M D POLLOCK

Brazing Weakens Copper

CRACKED ROTOR BARS on squirrel-cage induction motors are not uncommon on motors (1) using "across-the-line" starting and (2) designed for high starting current and torque.

For example, a motor inspected at one time, which showed broken rotor bars, had a poorly designed rotor. If *FLB's* rotor bars are brought to a common point and welded to the short-circuiting ring, *A*, sketch 1-*A*, he will find failure often occurs at points marked *x*. I have had bars fail at this point as result of stresses set up under starting and running vibration. To correct this we used a modification of design as at *B*.

I have found by hard experience that gas-brazing rotor bars to short-circuiting rings causes a reduction of the tensile strength of regular oxygen-bearing copper. I believe *FLB's* bars are regular copper. Failure of the new bars two weeks after first group were repaired indicates that he did not use the proper technique of rotor heating and cooling.

If *FLB* wants to know whether vibration fatigue caused original failure, he can send a fractured and a good piece of a bar to a metallurgist. He will take microphotographs, which show grain structure of the copper at the two locations.

To eliminate his maintenance problem *FLB* should purchase oxygen-free high-conductivity copper and rebuild his rotors. With this type copper in his rotors he can use a gas or oxy-acetylene flame for brazing without weakening the copper to a point where failure is a common occurrence.

Tenafly, N. J. K B HOFFMAN

Wedge Rotor Bars in Slots

UNDER LOAD, BARS in *FLB's* motor are pushed or pulled by the magnetic field. If they are not held firmly in their slots, constant vibration brings about a fracture in the metal. I suggest plugging bar slots so bars cannot vibrate at no load or full load.

To tighten rotor bars in the slots he may have to remove the old bars, and install new ones to wedge them tightly before end rings are welded in place. Use hardwood strips full length of slot.

Toronto, Canada J C NUTTER

Brace One Bar Against Another

VARYING SPEED of *FLB's* motor causes high torsion on rotor bars. This, along with variable centrifugal force also acting on bars, causes failure.

He may correct this problem by soldering or welding strips the width of rotor bars and ⅛ in. thick, from end of one bar to base of adjacent bar. Work from back of bar facing direction of rotation to base of next bar.

Quincy, Fla. D J PARMER

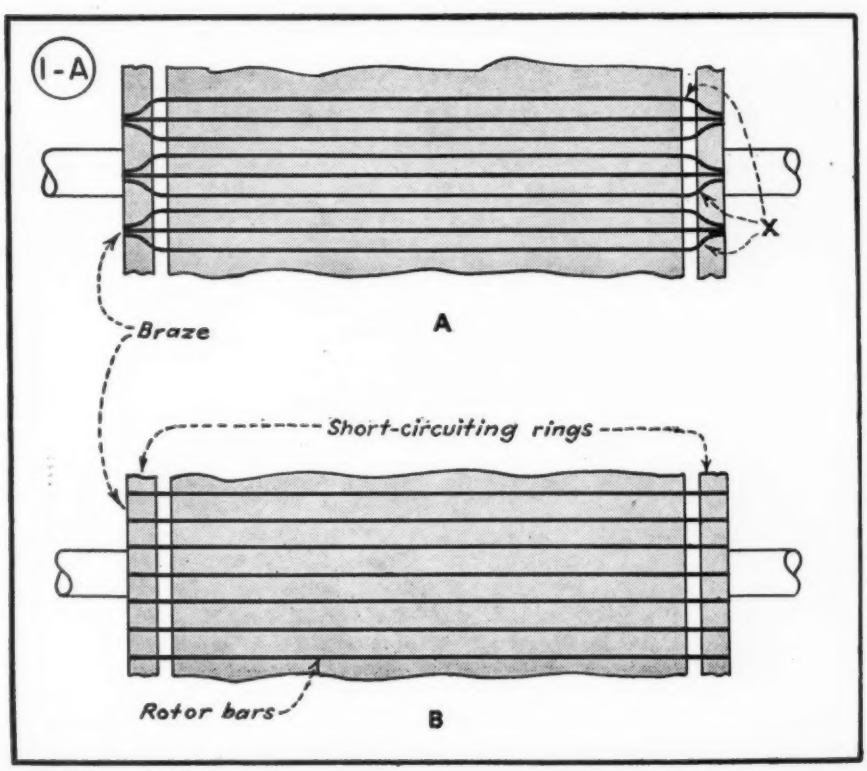
Loose Laminations Break Rotor Bars

ROTOR BARS BREAK in *FLB's* motor because laminations have become loose and are out of line as a result of machine vibration from several years' operation. When torque strain comes on the motor it puts an uneven strain on the bars and they are broken in a short time. He can correct his trouble by straightening and tightening the laminations and installing new bars.

Chillicothe, Mo. VAUGHN MURRAY

Braze Solidly Between Bars

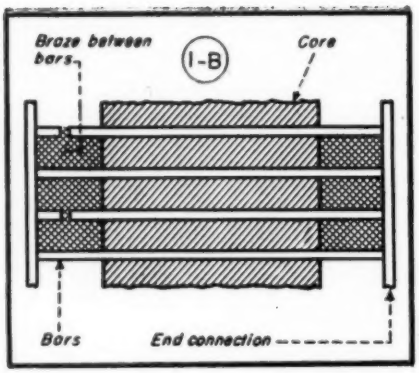
IN ALL PROBABILITY *FLB's* motor is normal-starting-current normal-starting-torque type. During period of biting into coal pile, current induced in the rotor winding is greatly increased over normal operation. Resulting excessive heat over a 2-year period has fatigued rotor bars until they have cracked. Subsequent repairs were not satisfactory because (1) heating the old bars resulted in further breakdown and (2) new bars are of different resistance

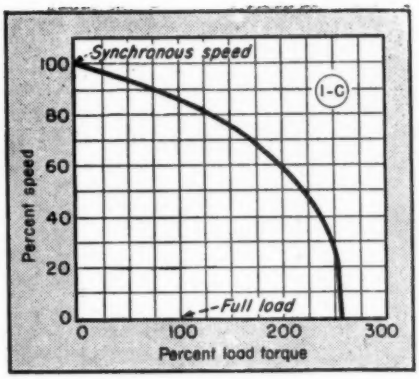


from old ones, causing unequal currents throughout squirrel-cage rotor. Probably the greatest current flows through new bars, causing failure.

If bars are cracked in the slots little can be done except to renew them. If breaks are outside the iron it is sometimes advantageous to braze solidly between bars and end ring, as in 1-*B*.

Amherstburg, Canada G O ELLIOTT





Overload Breaks Bars

SINCE SPEED ON *FLB's* squirrel-cage motor varies considerably with load changes, it is evidently a high-torque high-slip motor, with a high-resistance rotor winding. As indicated by speed torque curve, 1-*C*, his motor can carry two and a half times normal torque load before it stalls. Thus, current may be five or six times full-load value. This combination of heavy mechanical shock load, plus intense heat generated by heavy current (heat varies as square of current), doubtless causes failure.

This trouble is not unknown on squirrel-cage motors working on loads requiring frequent acceleration and reversing. I have known many such complaints corrected by solid-steel rotor cores having steel of high electrical conductivity. During speed changes, most rotor energy loss is confined to the steel core instead of the high-resistance rotor bars. This type construction is relatively new although it has been used long enough on various applications requiring severe starting to prove its worth.

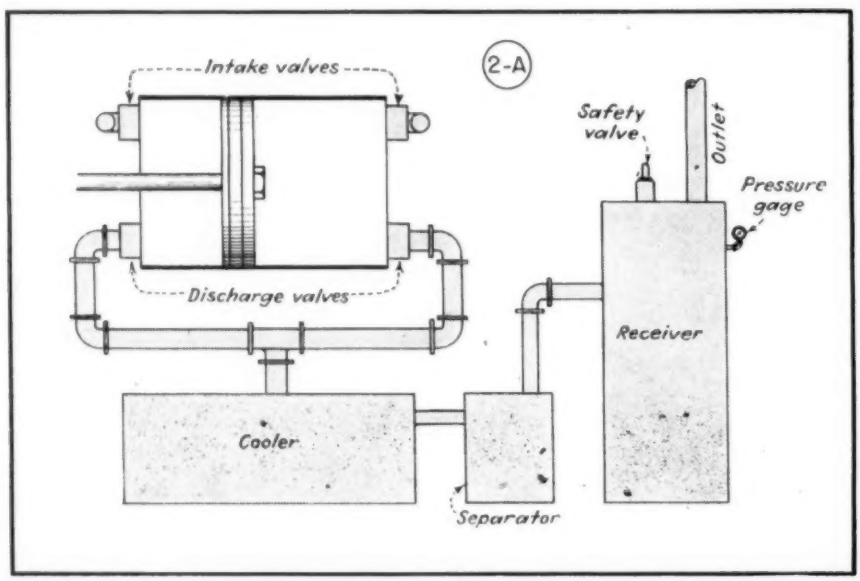
New York, N. Y. R F ERSKINE

What Is Cause of Compressed-Air Explosion?

(This is Question 2 from the September issue, with best answers from readers)

We operate three 500-cfm air compressors. Even though we have had no trouble we believe that explosions have occurred, which might have had serious results, in air receivers and other parts of the air systems. We think we do a pretty good job in operating these machines safely, but as a precaution I would appreciate suggestions from Power readers on how best to guard against compressed-air explosions.

We have been told that leaky discharge valves are a common cause of compressed-air explosions. If they are, what is the reason? It does not seem possible that recompression of air would produce high enough temperature to ignite oil vapors or other combustible material that might be in the air before it is compressed.—SHC



Use High-Grade Oil On Air Compressors

ONE OF THE CHIEF CAUSES of explosions in compressed-air systems is improper and excessive lubrication. Oil is vaporized and carried into the system. If there is a spark of hot carbon, or if the air temperature is as high as flashpoint of oil vapor, explosion or fire results. Leaky valves cause air temperature to rise above normal temperature of compression, which forms excess carbon. Use only high-grade lubricant for compressors.

A cooler may be installed in the system to remove part of compression heat and give additional safety margin. Typical arrangement for a compressed-air system is shown in 2-*A*.

Parr, S. C. V C SUMMER

Prevent Discharge Valves From Leaking

LEAKY DISCHARGE VALVES are the commonest cause of compressed-air and oil-vapor explosions, but there may be secondary factors. Most discharge valves nowadays are thin plate, which is liable to develop cracks. Compressed air passing through these cracks becomes overheated.

In addition to oil vapor, which is nearly always present around air valves, carbonized oil and other inflammable matter is likely to stick to the valves. Also, there may be an oil film inside the discharge piping and at sides and bottom of air receiver. Explosion touched off at discharge valves is thus carried to receiver.

Best ways to guard against explosions are: (1) Keep air valves clean and in good condition. (2) Pro-

vide adequate and uninterrupted supply of cooling water. (3) Avoid running compressor unloaded as much as possible. (4) Do not allow oil and dirt to accumulate in receiver. Thoroughly drain receiver at least once each working day.

Dolbeau, Que. E S RIVETT

Too Much Oil Causes Explosions

MOLECULAR FRICTION caused by air compression results in high temperature. For example, air at absolute pressure and 60 F, compressed without cooling to 15 atmospheres or 220 psi will reach 681 F—hot enough to cause plenty of trouble. However, compressors usually have a means of cooling, normally by water. Inter- and aftercoolers absorb heat generated by compression, as well as jacketed cylinders. Trouble may be averted sometimes by keeping sludge and scale cleaned out of the units, and permitting the designed heat exchange to function correctly. This results in lower air temperatures, and reduces explosions.

Greatest cause of compressor explosions, however, is too much oil. A compressor must operate with minimum oil. Some excess oil, subjected to highly compressed air before the air is cooled, is changed into carbon. This carbon gets under the discharge valves permitting air to leak back. Excessive heat vaporizes excess oil deposits and an explosion results.

The distinctive odor of a compressor on fire is easily detected. It should be stopped immediately.

Leaking discharge valves are easily caught by stage gages. Stages should be drained regularly, thereby getting rid of some excess oil, and water and carbon particles. Main precaution, however, is to use an absolute minimum of good compressor oil.

F. C. HUMPHREYS

Deming, New Mexico

Explosion May Exceed Receiver Safety Factor

COMPRESSED-AIR TANKS may explode from one of three causes: (1) progressive weakening due to deterioration. (2) development of a major defect such as cracking of longitudinal joint (3) excessive pressure due to inadequate or defective safety valve, and (4) combustion explosion of vapor contents.

Inspections should reveal development of the first two causes since deterioration due to internal corrosion and pitting usually takes many years.

Influence of abnormal temperatures on tank strength is shown in 2-*B*. As temperatures increase, air-tank strength diminishes. These curves illustrate combined effects of abnormal temperatures and deterioration. Do not be misled by the curves, however. If combustion is rapid enough a pressure wave of a magnitude up to about six times working pressure may result.

One of the best safeguards against this type explosion is a thermometer and high-temperature limit switch on the compressor discharge pipe. This bulb should be adjusted to trip if temperature rises more than 50 F above normal. This safeguard should prevent accidents from cooling-water loss.

Canton, Mass. H M SPRING

Avoid Over-Lubrication

AIR-COMPRESSOR EXPLOSIONS are usually caused by ignition of lubricating-oil vapor resulting from abnormal operating temperatures. *SHC* is mainly concerned with source of the abnormal temperatures; here they are:

1. Unsuitable lubricating oil results in the evaporation of lighter fractions and the deposit of oxidized "heavy ends" on the discharge valves. In the course of time this restricts free air passage from the cylinder creating excessive temperatures.

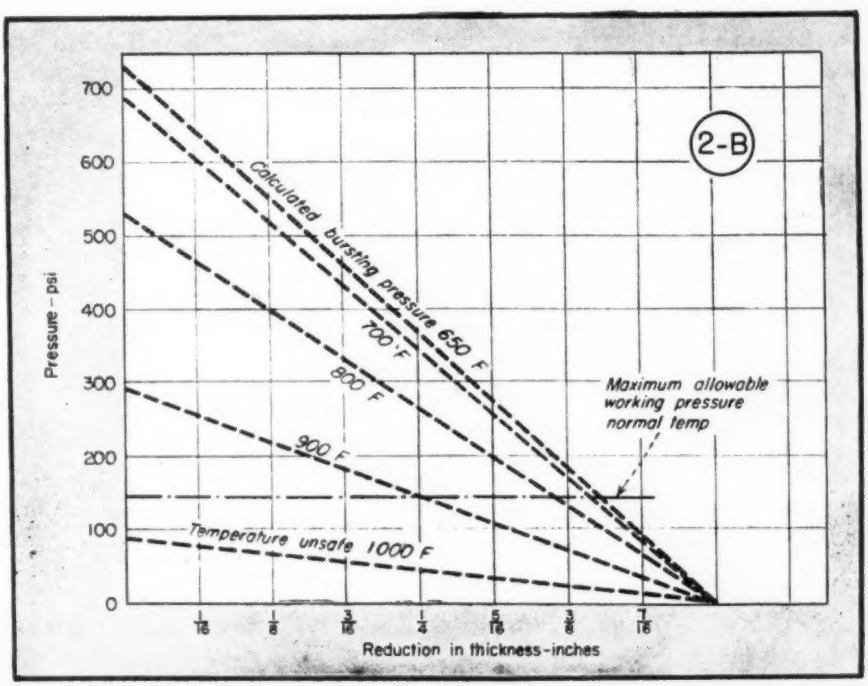
2. Dirty intake air containing dust particles or other foreign matter when drawn into cylinder with air is forced against the discharge valves. This dust has a tendency to adhere to the oil-wet surfaces and obstruct the free passage of air.

3. Inadequate cooling caused by hard water for cooling purposes may deposit scale at "hot spots" adjacent to discharge valves. Dirty water may result in the silting up of passages. Both conditions create approximately adiabatic compression, which results in high temperature and corresponding breakdown of lubricating oil. While this condition does not of itself cause ignition of oil vapor, increased temperature imposes too much of a burden even for good oil, which eventually will "bake" on valve surfaces. In time this also restricts air passage.

It is not definite that recompression causes explosions. Temperatures from leaky discharge valves can be computed; curve flattens out at the sixth compression after leakage starts, assuming a single-stage watercooled air compressor compressing to 80 psig with 10% leak. However, take an extreme case: recompression with 25% leak-back in conjunction with inadequate cooling, described in 3 above. With this case ratio of specific heat is different. Whereas it was 1.3 it is now about 1.4. Curve flattens out after ninth compression but has terminal temperature of 727 F. This is approaching the critical zone and, with other factors mentioned, the situation is serious.

To prevent explosions observe these rules: (1) Use an oil, recommended by a good manufacturer, which is chem-

(*Continued on page* 164)



RECIPROCATING-PUMP Q&A FOR POWER ENGINEERS

By E F WRIGHT

3—Characteristics of Direct-Acting Pumps

Third in a monthly series by E F Wright, acting chief engineer, reciprocating pump division, Worthington. This expert on reciprocating pumps has selected questions and answers that give practical understanding of these pumps, their construction, operation, characteristics, troubles and remedies.

Q 1—What are the major advantages of a direct-acting steam pump?

A—A direct-acting pump is simple, flexible, reliable and low in cost. It is a complete unit, consisting of pump or fluid end and driving element or steam end, and does not require a separate motor or other power source. Simple and inexpensive to install, the pump is easy to operate and control, and most maintenance does not require highly skilled mechanics. Because of this unique combination of advantages a large number are still built with virtually no fundamental changes in design or construction from those established almost a century ago.

Q 2—For what pressure-and-capacity ranges are direct-acting pumps built?

A—Their greatest uses are in the moderate-capacity and pressure field, and they are often used as standby pumps. Where ratio of pressure to capacity is large or where viscosity of fluid pumped is high enough to be important, these pumps have distinct advantages. They are most economical where exhaust steam is used for heating or process work.

Q 3—What factors govern maximum pressure that direct-acting pumps develop?

A—Primary factors are: (1) available steam pressure (2) ratio of steam-piston and fluid-piston areas (3) operating speed. Exhaust pressure and suction pressure or lift also influence the pressure developed. Fig. 1 diagrams a direct-acting pump. Motion of the two pistons, and piston rod connecting them, is proportional to unbalance in forces acting on the pistons. Maximum or stalling discharge pressure is nearly equal to effective steam pressure times steam-piston area divided by fluid-piston area. As pump speed increases, developed discharge pressure decreases because of fluid friction in steam and liquid ends, and packing and mechanical friction.

Q 4—What method is used to control a direct-acting steam pump's delivery?

A—Steam supply is throttled either by the operator or an automatic device to meet the requirements of a specific service. Since a direct-acting pump is a variable-speed machine it is never necessary to throttle its discharge as on a constant-speed centrifugal. A direct-acting pump may be controlled from liquid level through a float and linkage to a throttle valve, or by a constant-pressure or excess-pressure governor. The latter is well adapted to a boiler-feed pump where boiler pressure may fluctuate through relatively wide limits. A bypass is not needed for low or zero capacity because the governor may stop or start a direct-acting pump to meet any conditions.

Q 5—Is a pressure-relief valve necessary on the discharge side of a direct-acting pump?

A—While many such pumps operate for years without a relief valve, it is usually a good investment. Stalling pressure for most pumps is at least 50% greater than operating pressure because of losses in the pump and pressure drop in steam line and control valves. When steam-piston area is much larger than liquid-piston area, as on boiler-feed pumps, maximum discharge pressure may be from 2 to 2.5 boiler pressure. Under certain conditions simplex pumps occasionally build up pressures greatly in excess of normal rated pressure.

Q 6—Is the inherently high steam consumption of direct-acting pumps a disadvantage?

A—It is not when exhaust steam is used for heating feedwater, for building heating or process work. Because these pumps can operate with a considerable range of backpressure it is possible to recover nearly all heat in the steam required to operate them. Since they do not use steam expansively, they are actually metering devices rather than heat engines and as such consume heat from the steam only as it is lost in radiation from steam end of pump. These pumps act in effect like a reducing valve to deliver lower-pressure steam, which contains nearly all its initial heat.

Q 7—How does operating steam pres-

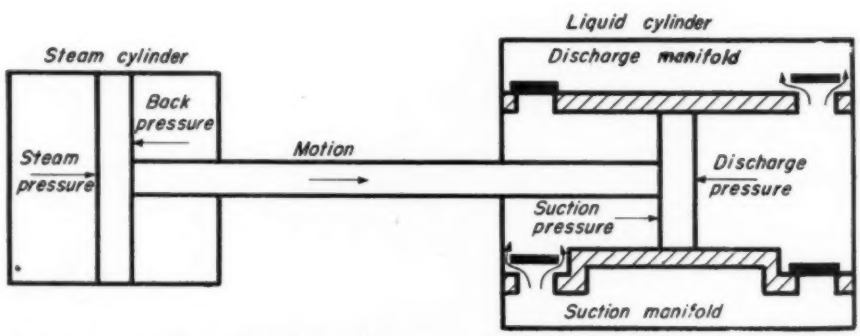


Fig. 1—Simplified diagram of direct-acting pump shows direction of forces on pistons. Rate of motion is proportional to unbalance of forces' action on them

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PUMP Q&A

Continued

sure affect steam consumption of a direct-acting pump?

A—Weight-to-volume relationship of saturated steam at various pressures is such that theoretical steam consumption in terms of pounds per hphr is a minimum in the 400-to-500-psi range, and increases more and more rapidly as pressure decreases. It was generally believed that a compound or triple-expansion pump was required to get steam consumption less than 80 or 90 lb per liquid hphr. Marine experience during the last 10 years shows that a simple pump can operate on less than 50 lb per liquid hphr when steam-cylinder pressure approaches 400 psi and the steam end is properly insulated. Where steam consumption is an important factor and sufficient steam pressure is available, considerable saving can be made by selecting a steam-cylinder size requiring highest practical steam pressure.

Q 8—Does the steeply sloping exhaust line of indicator card, Fig. 2, indicate serious restriction in the exhaust passages or piping?

A—While it is not common for operators to take indicator cards from direct-acting steam pumps, a card like Fig. 2 should not cause alarm. The moving assembly of these pumps is a delicately balanced mechanism, sensitive to pressure change on both sides of each piston. If discharge pressure builds up gradually during most of the stroke, the piston assembly starts moving as soon as steam-piston exhaust pressure drops appreciably below steam pressure. Motion continues at whatever rate is required to maintain the moving balance of forces, with exhaust pressure dropping as discharge pressure rises.

This card is typical of a pump with a small-discharge cushion chamber on water end in which pressure drops sharply while the pump is reversing and builds up gradually during most of the stroke. The same pump would produce an almost rectangular indicator card if discharging through a short, open line to a boiler or to a large receiver with practically constant pressure. With uniform resistance on the discharge side of the fluid piston, the pump's pistons will not move until steam-cylinder exhaust pressure approaches exhaust-line pressure.

Q 9—Because a direct-acting pump is a positive-displacement machine, capable of priming itself at considerable lift, does it have good "sucking" qualities?

A—No machine or device can "suck" fluid from a lower level. Piston motion can do no more than lower pressure within the cylinder to the point where atmospheric pressure of an open-suction supply can force liquid up suction pipe into pump cylinder.

Q 10—How does clearance volume affect priming ability of direct-acting pumps?

A—In a dry pump—without liquid in the cylinders—ratio of clearance volume to displacement has a direct effect on pump's priming ability. To evacuate suction line, pump must compress air within cylinder and discharge some of it on each stroke. Before additional air can be taken in from suction line, air remaining in clearance volume must expand to less than suction-line pressure. Thus a large clearance volume greatly limits priming ability of a dry pump.

Filling clearance volume with fluid largely nullifies its effect. In a submerged piston pump, such as the common cap and valve-plate design, filling cylinder with liquid makes pump self-priming at any reasonable lift.

Q 11—What is maximum practical suction lift of a direct-acting pump?

A—With cold water at sea level, an average pump can operate at a lift of about 22 ft. Fig. 3 shows influence of temperature and altitude on a pump capable of a maximum lift of about 26 ft. Difference between maximum theoretical lift, 34 ft, and maximum practical lift represents losses through the valves and entrance losses, velocity head and pipe friction in suction line.

Q 12—What vacuum can be maintained with a wet-vacuum pump?

A—A wet-vacuum pump when well designed can maintain a vacuum nearly equal to condensate vapor pressure along as air leakage is not excessive. This is high enough to obtain the best over-all efficiency from a compound or even a triple-expansion reciprocating steam engine. Special wet-vacuum pumps applied to process work maintain vacuums as high as 29 in. Hg.

Q 13—With water at 212 F, what suction head does the average direct-acting pump require?

A—Assuming standard atmospheric pressure on the water surface, average pump at normal speed requires positive

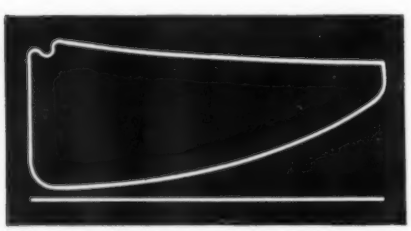


Fig. 2—Typical steam-end indicator card taken from a direct-acting pump

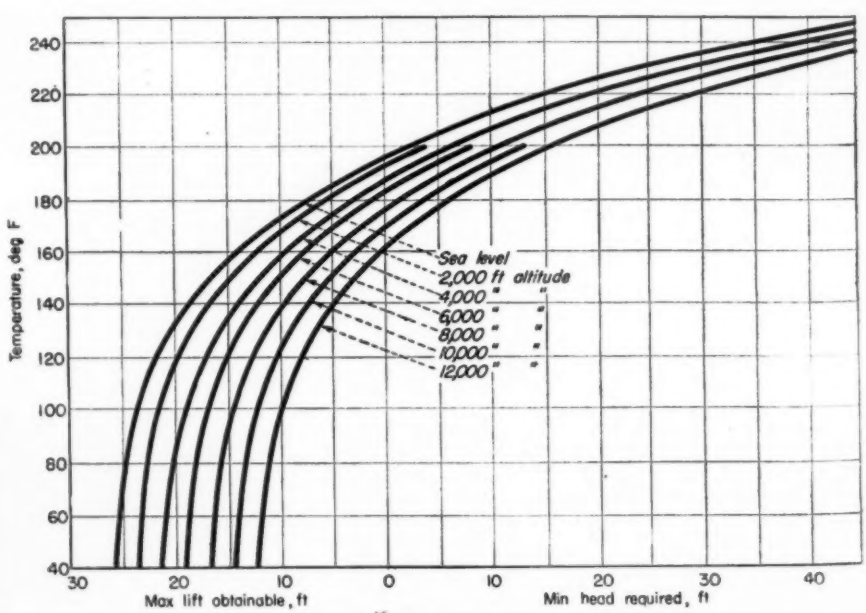
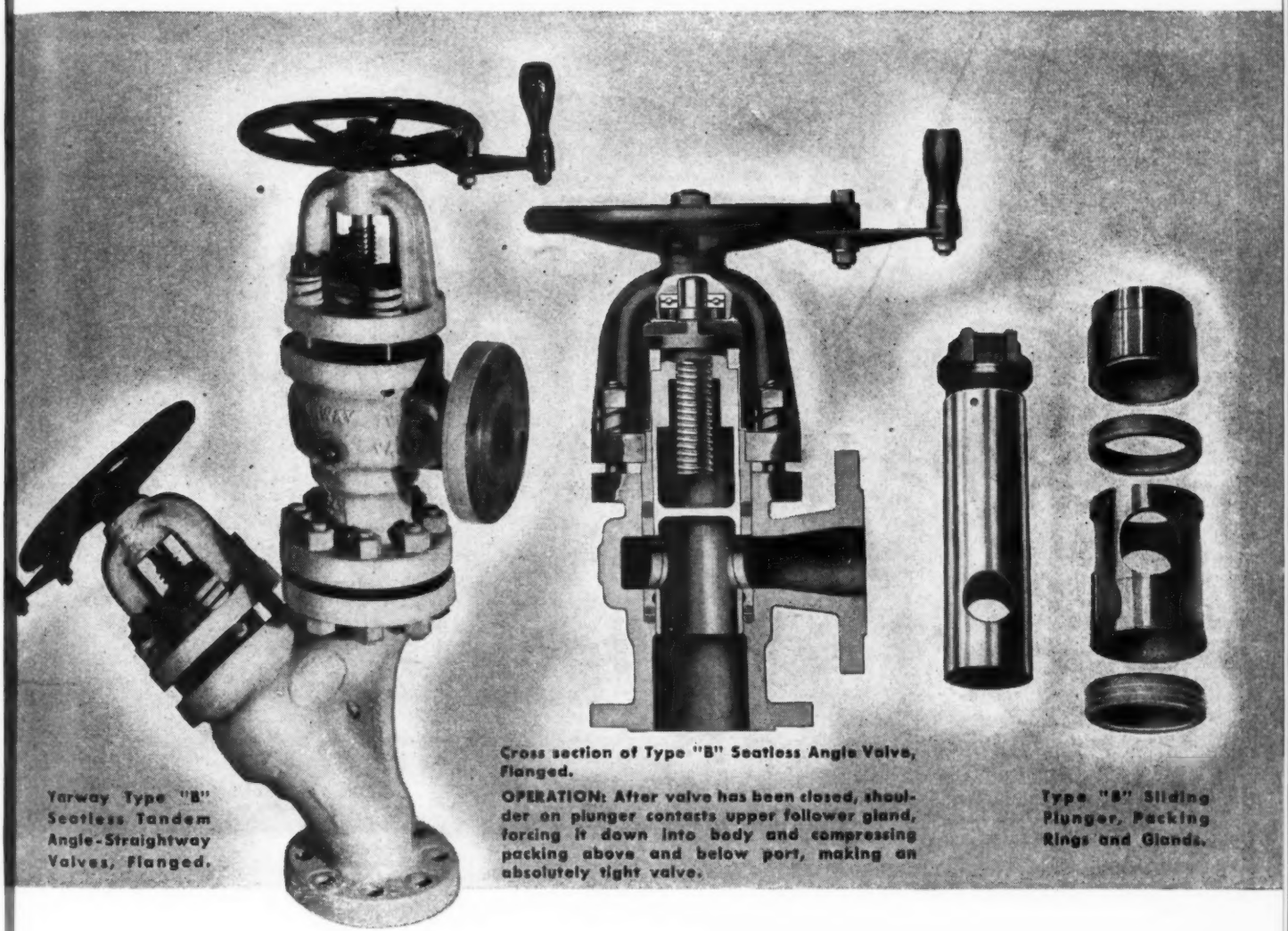


Fig. 3—Curves show maximum suction lift obtainable with and minimum suction head required by a reciprocating pump handling water at different temperatures

NO SEAT!

TO SCORE...WEAR...CLOG...LEAK



Yarway Type "B" Seatless Tandem Angle-Straightway Valves, Flanged.

Cross section of Type "B" Seatless Angle Valve, Flanged.

OPERATION: After valve has been closed, shoulder on plunger contacts upper follower gland, forcing it down into body and compressing packing above and below port, making an absolutely tight valve.

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PUMP Q&A

Continued

suction head of about 10 ft. This should be expressed as net positive suction head (NPSH) of 10 ft. The NPSH, or head in feet of liquid pumped in excess of vapor pressure, should always be basis of comparison. NPSH of 10 ft of 212-F water is about equal to lift of 24 ft of 65-F water. For details on NPSH see POWER, Nov 1945, p 120.

Q 14—What are duplex direct-acting pump's flow characteristics at normal speed?

A—In theory, a duplex pump should maintain steady flow and constant pressure. Practically, influences of moving parts' inertia, mechanical and fluid friction, slip, and unbalanced area of valves make this ideal unattainable. A properly adjusted duplex pump should have a flow characteristic approximating Fig. 4. While actual flow may be nearly as shown, pressure may fluctuate at each reversal because of rapid acceleration and slowing down of moving parts. At rated speed there is almost no overlapping of strokes on the pump's two sides. One piston is at rest while the other is moving at a velocity nearly constant throughout 90 to 95% of its stroke. At the stroke's end this piston stops quite sharply while the other starts almost as quickly. At normal speed the average pump makes a stroke slightly greater than the rated stroke.

Since one side of a duplex pump is idle most of the time, simplex-pump enthusiasts claim that the duplex is no better than a simplex of the same cylinder size. However, there is a great difference between the sustained, if not the steady, flow of a duplex and the interrupted flow of a simplex. Too little is known about the improvement minor adjustments sometimes make in everyday operation of a duplex steam pump.

Q 15—What are flow characteristics of a duplex pump at reduced speed?

A—Fig. 5 shows flow characteristic of a duplex at reduced speed. Overlapping stroke frequently assumed to be characteristic of the duplex is obtained, but unfortunately only at a reduced stroke. Each piston moves independently during middle half of each stroke and at a velocity essentially constant. When opposite piston starts at low speed, velocity of the already moving piston is reduced quickly to the point needed to maintain approximately average delivery. When one piston stops the other quickly accelerates to reestablish average delivery. At full speed, moving parts have sufficient inertia to maintain nearly constant piston velocity. This is not true at low speed when varying frictional forces exert a stronger influence causing minor but frequent variations in piston velocity.

Q 16—What are flow characteristics of a simplex steam pump?

A—Fig. 6 shows flow characteristic of a simplex steam pump under boiler-feed conditions, where discharge pressure is fairly well sustained except when pump is at rest. Fig. 7 shows performance under tank-pump conditions where discharge pressure is nearly proportional to piston velocity. In a simplex a pause is necessary at each end of the stroke during the time required for the forces on both sides of steam and liquid pistons to reverse.

Time of this piston pause may seem exaggerated even to the experienced operator, but actual tests show that under boiler-feed conditions the pause may seem short and still take 15 to 25% of the time for a complete single stroke. This pause at reversal may seem a serious disadvantage but it is necessary to proper functioning of the fluid valves. Since piston velocity is essentially constant until near the stroke's end, the liquid valves cannot b gin to close until just before reversal. An appreciable pause is needed for valves to seat gently instead of being slammed against their seats by sudden flow reversal.

Q 17—Can a direct-acting simplex boiler-feed pump designed for a 400-psi boiler be used on a system operating at 185-psi maximum?

A—Yes, but all pump parts are unnecessarily heavy and costly for such operation. All steam pumps for boiler-feed service are designed with the steam-piston area from 2.25 to 2.5 times the liquid-piston area to insure sufficient pressure to overcome boiler pressure, plus resistance of the boiler-feed regulator and pipe friction. The average boiler-feed pump never requires full available steam pressure, even at excess speed with high exhaust pressure; instead it always has plenty in reserve to meet any condition. Operation at lower boiler pressure may be compared to that existing while a boiler is being brought up to pressure. During this period the direct-acting pump has no difficulty in feeding water to the boiler at 50, 100 or 200 psi even though the plant is designed for 400 psi.

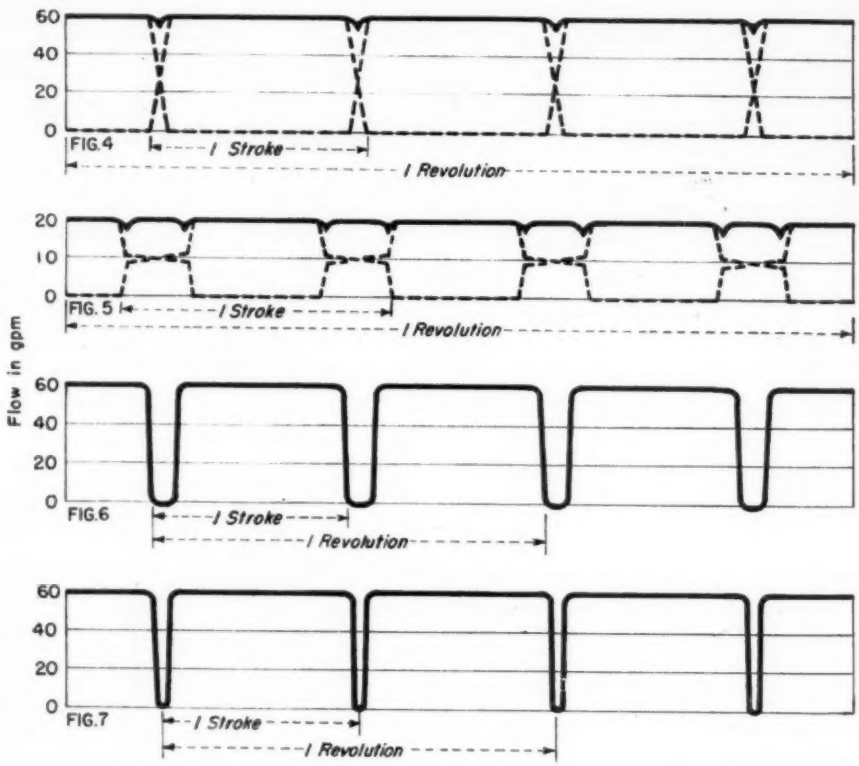

Fig. 4—Fluid-end flow curves for 6x4x6-in. duplex pump operating at full speed. Fig. 5—Same as fig. 4 but with pump at one third speed. Fig. 6—Flow curves of 8x5x12-in. simplex pump under boiler-feed conditions. Fig. 7—Flow curves of a 5.5x5.5x7-in. simplex pump operating under tank-pump conditions

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WATER-TREATMENT QUESTION BOX

How Does Internal Treatment Work?

By K M Herstein and John S G Shotwell

▶ THIS SIXTH QUESTION in the water-treatment series discusses internal treatment, what advantages it offers, and how it acts.

Goodwater Laboratory
Drum City, U. S. A.
Dear Chemist:

Some engineers swear by internal boiler treatment; others stake their reputations on external treatment. Both methods seem to work, so I would like to know whether one has any advantage over the other. Exactly how does each method work?

Yours truly,
Walter Tender

Dear Walter:

Your inquiry covers too much ground to be answered in one letter so I shall answer it in two.

Boiler feedwater treatment means the preparation of raw water by adding chemicals, etc so it will not form boiler scale, cause corrosion or caustic embrittlement. Exact treatment varies with each installation, taking into consideration boiler size and type, working pressure, exact composition of impurities in the raw water. It is impossible, therefore, to discuss in general terms the relative merits of internal and external treatment.

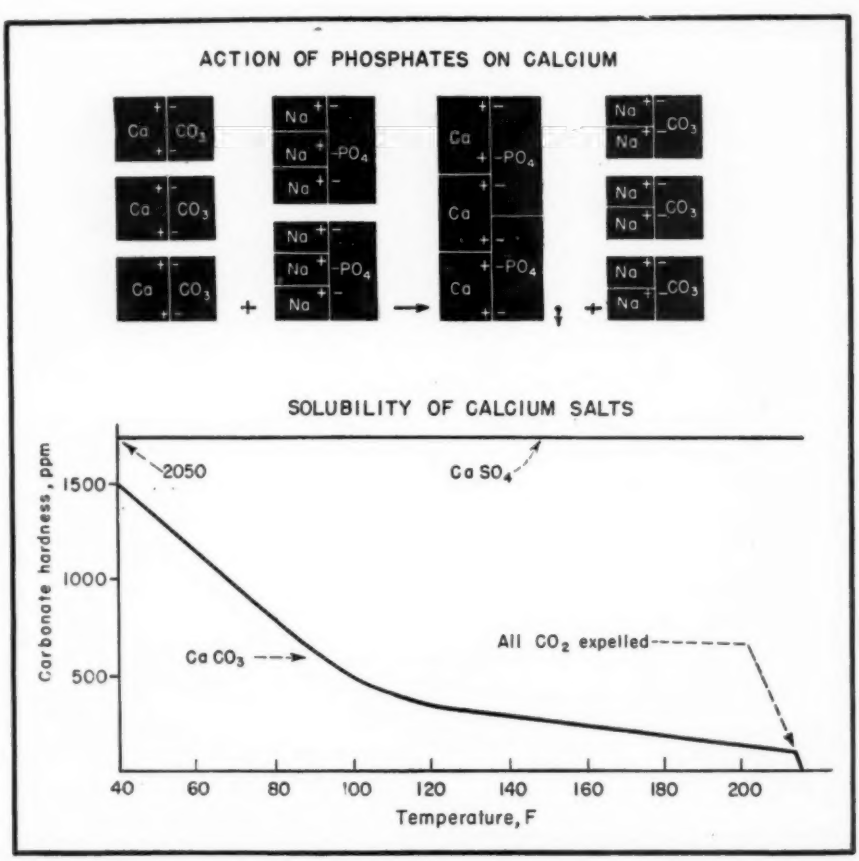
In small installations working under low pressure and with relatively soft feedwater, internal treatment has proved more economical. In large plants with very hard or saline water, external treatment has been used to good advantage, but very high-pressure jobs have employed a combination of external and internal treatment. It is impossible to say which one of several combinations should be employed unless actual plant operating conditions are taken into consideration.

Internal treatment has a twofold object. First, to convert soluble scale-forming constituents into an insoluble sludge. Second, to maintain this as sludge and prevent it sticking to the boiler surface. It requires minimum water-treating equipment, and cost of chemicals may be less than for external treatment. Quantity and character of sludge produced within the boiler limits its efficient use. The higher the boiler pressure and rating, the smaller the amount of sludge and dissolved solids that can be tolerated. These consist of carbonates and phosphates of calcium and magnesium, together with organic material carried down as the sludge settles.

After boiler water is properly softened to prevent scale, it must be conditioned to prevent the production of corrosion or embrittling conditions. Also, sludge must collect in suitable form. Numerous chemicals are used to preserve the sludge. Those in commonest usage are colloidal iron, starch, tannins, and petroleum byproducts. They depend upon colloidal action exerted on sludge particles to prevent their growth and crystallization upon the hot boiler surfaces.

When total solids in the water are high or boiler operating conditions too severe it may be advisable to remove all or most of the impurities from the water before it goes to the boiler. This method will be discussed in the next article in the water-treatment series.

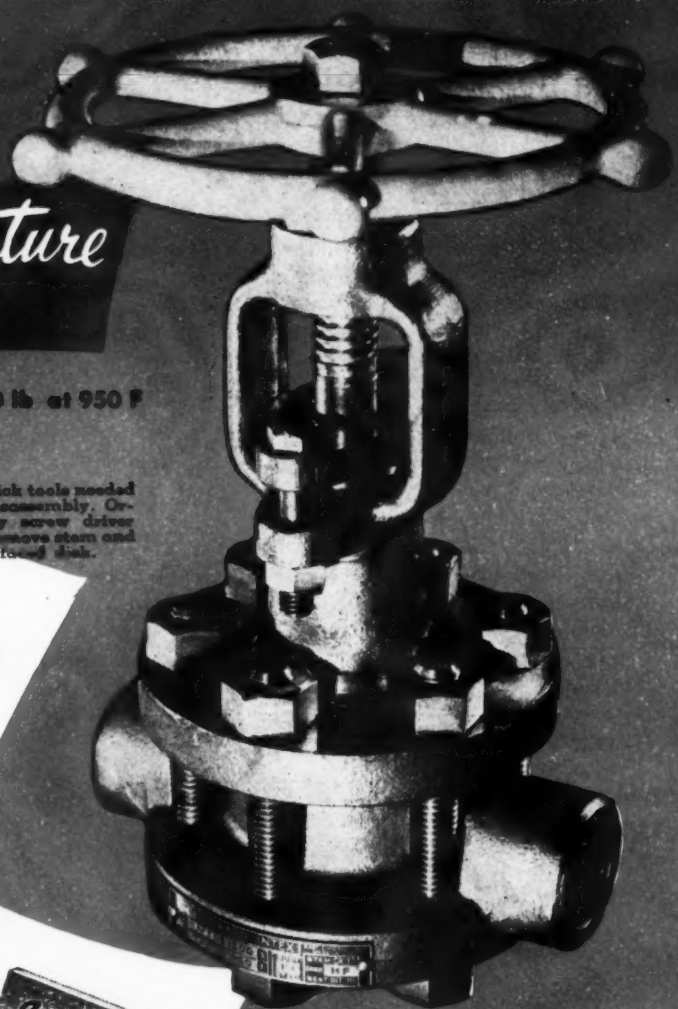
Yours truly,
Chemist
Goodwater Laboratory

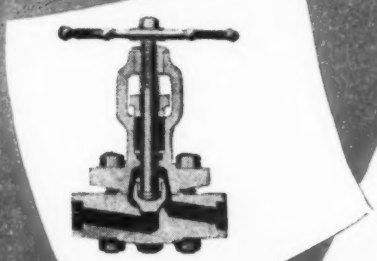


Above: Trisodium phosphate precipitates calcium as tricalcium phosphate, forms soluble sodium carbonate. Below: How the temperature affects salts

WHY EDWARD INTEX VALVES ARE SPECIFIED for THE MAJORITY* OF *top Pressure-Temperature Jobs*

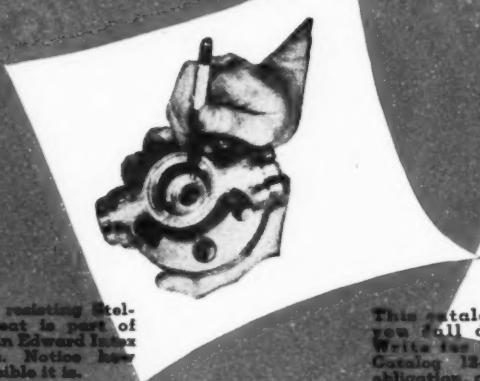
Rating: 1500 lb at 950 F



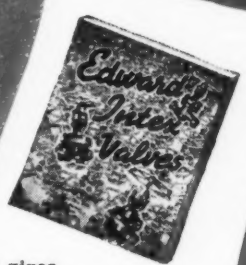


Oversize handwheel, bronze yoke bushing, deep stuffing box, body-bonnet joint at the seat line—all are Intex Valve features.

No trick tools needed for disassembly. Ordinary screw driver will remove stem and hard-faced disk.



Wear resisting Stellite seat is part of body in Edward Intex valves. Notice how accessible it is.



This catalog gives you full details. Write for Edward Catalog 12-03. No obligation, of course.

If, for your top temperature-pressure jobs, you want a welded bonnet instead of bolted bonnet valve, look into the advantages of the Edward Univalve design. Write for details.

DELIVERIES FROM STOCK!

Many Sizes

Regardless of pressure and temperature, there are always services on which many operators insist on a bolted bonnet valve. For those jobs, Edward Intex valves are specified in a big majority of cases.

The hard faced seat is integral with the body, and the disk is also faced with erosion-fighting Stellite. Maintenance, though seldom necessary, is unusually simple. No special tools are needed for disassembly and the body and bonnet join just above the seat line, where all working parts are easily accessible. No modern valve is easier to relap.

Available in socket welding, screwed or flanged ends from ¼ in. to 2 in., Intex valves are rated at 1500 lb. at 950 F. but are equally trouble-free and economical in intermediate service.

Believing that all three types have some advantages, Edward builds bolted bonnet, welded bonnet and pressure sealed bonnet valves for high temperature service.

*Based on a recent survey by an industry magazine.

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO EAST CHICAGO, INDIANA

"Intex" is a registered trade mark of Edward Valves, Inc.

MATH TIPS

JOHN KING GIVES HELPFUL HINTS TO EVERYDAY USERS OF NUMBERS AND HOMESPUN MATHEMATICS

18—SLIDE RULE, Part 4: Computations Cut Short

▶ SO FAR OUR SLIDE-RULE TIPS have explained multiplication, division, proportion, squares and cubes as single operations. But one outstanding feature of the slide rule is that it combines many of these operations in solving engineering problems. Before studying this page of shortcuts, review first three parts on the slide rule (POWER, Aug, p 120; Sept, p 128; Oct, p 126).

SIMPLEST COMBINATION

Most everyday problems involve multiplication and division. Since this is the simplest slide-rule combination it should be thoroughly understood before taking up others.

Problem: $\dfrac{347 \times 62.5}{282} = ?$

This type of problem is made simple by performing division first. Set 282 on *C* scale over 347 on *D* scale. Since the index indicates results, it is automatically in position to multiply; therefore, move the indicator to 62.5 on *C* scale, and read the answer 77.0 on *D* scale, Fig. 1.

These problems aren't always so simple on the Mannheim rule; for example:

Problem: $\dfrac{136 \times 33}{51} = ?$

As before, divide first. Set 51 on *C* scale over 136 on *D* scale. Results cannot be multiplied by 33 directly because this figure is off *D* scale at left. As explained in part 1, August, POWER page 120, when this condition occurs in multiplication, move the other index to position occupied by first index. Since the index indicates the results of division, mark its location with hairline of indicator and move the opposite index, 1 in this problem, to indicator hairline. Continue the problem by sliding the indicator to 33 on *C* scale. and reading answer 88 on *D* scale.

"CI" MULTIPLIES BY DIVIDING

Another method of solving this problem uses the *CI* scale. This is *C* scale, inverted or reversed. Therefore, when any number on *D* scale is divided by a number on *CI* scale, results are the same as when multiplying by the number on *C* scale. Also, when a number on *D* scale is multiplied by a number on *CI* scale, results are the same as when dividing by the number on *C* scale. This procedure consists of multiplying or dividing by the reciprocal, or one over the number, which is the same as dividing or multiplying by the number.

Problem: $\dfrac{136 \times 33}{51} = ?$

Divide 136 by 51 and move the indicator to mark location of the index as explained above. Instead of exchanging location of indexes, move the slide until 33, *CI* scale, lines up with hairline of indicator. This problem is worked out in Fig. 2 and shows that result of 136 divided by 51 is divided by 1/33, which is the same as multiplying by 33. Net results are the same as indicated in the problem above.

Remember, *CI* scale is reversed; be sure not to set off 27, thinking it is 33. Read answer 88 on *D* scale under index at right.

Problem: $\dfrac{86 \times 4382 \times 2.72}{11.7 \times 92.8} = ?$

By inspection pick out the division combinations that fit easily on the slide. That is, pick numbers that have the first digits very nearly equal. Do not attempt to divide 86 by 11.7. Instead, divide 86 by 92.8, and multiply results by 2.72. Mark results with the indicator; divide by 11.7. Then multiply results by 4382 on *C* scale. Only the final answer, 945, is observed or recorded; values of intermediate steps are ignored.

This process can be carried as far as the problem goes and only the final answer is recorded. A method for locating the decimal point will be described in a later issue.

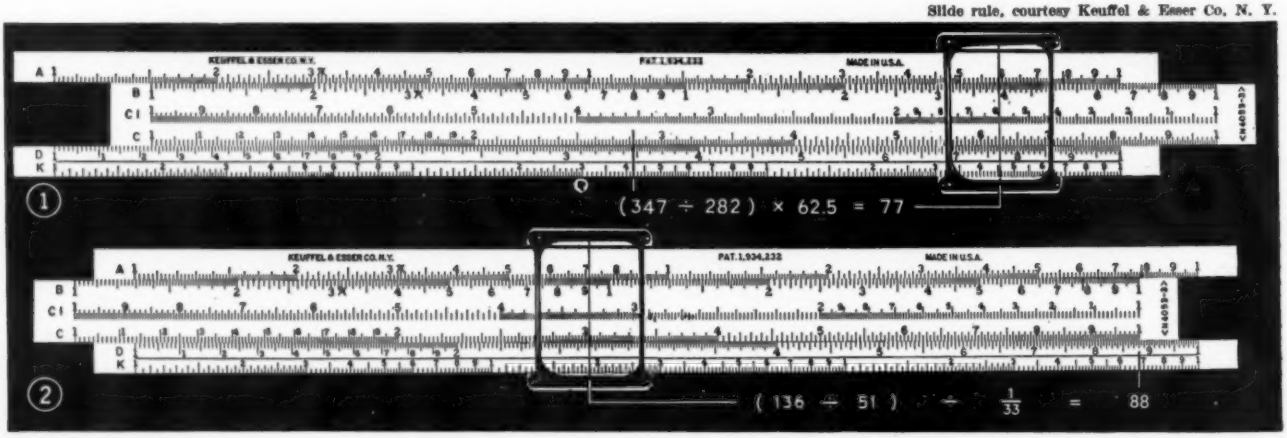
Problem: $3146 \times 185 \times 482 \times 84 = ?$

Divide 3146 on *D* scale by 185 on *CI* scale, and multiply by 482 on *C* scale. Divide results by 84 on *CI* scale, and read final answer 23,580,000,000 on *D* scale under index.

In learning the use of the *CI* scale, check results by straight division and multiplication methods until you become familiar with the inverted scale.

More about shortcuts next month.

Slide rule, courtesy Keuffel & Esser Co. N. Y.

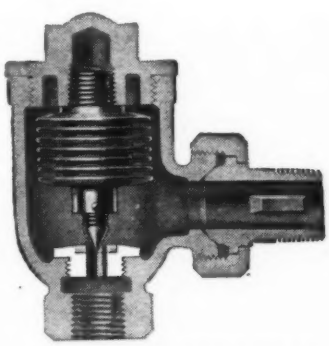


This Webster System served 23 years with practically no Radiator Trap repairs

HOTEL BELLERIVE, KANSAS CITY, MO.
Built in 1922. Architect, Preston J. Bradshaw, St. Louis.
Owner, Barney Goodman. Operated by Beacon Rental Co.

This is the story of 605 radiator traps — and how they served for 23 years with practically no repairs.

In selecting equipment for the Hotel Bellerive in 1922, Architect Preston J. Bradshaw, of St. Louis, sought long life and low maintenance cost. He specified Webster Sylphon Traps for which the contractor paid $3.68 each.



WEBSTER SYLPHON TRAP
Originally installed in Hotel Bellerive. Darker portion shows replacement made after 23 years service.

For 23 years, heating comfort was unimpaired and this building required only 24 new radiator trap interiors—one per year.

They might have bought traps at $2.00. But, what happens to economy when such a trap becomes inoperative? Add 90 cents for new interiors at five-year intervals and you would have a trap cost of $5.60 to date compared with $3.68 for the best available equipment.

Also important is the trouble-free heating service provided by Webster Equipment—the avoidance of heating complaints which might have meant added indirect cost — even loss of rental income.

FRED N. SCHAAD
Webster Representative in Kansas City. Schaad moved to Kansas City from Columbus about a year ago after having been a Webster Sales and Service Representative in the Ohio capital for 18 years. He is typical of the men who make possible Webster's service to customers.

During the 1944-45 heating season a complete check-up and overhaul of all traps was begun by the Hotel Bellerive. Replacement of worn interiors with genuine Webster Sylphon Attachments, each with new bellows, valve piece and insert seat gives the hotel a better trap than the original one because manufacturing processes have improved, bellows are stronger and more uniform, valve piece and seat are now stainless steel whereas in 1922 they were brass.

Of course, this service record of Webster Equipment would not have been achieved without conscientious operation of the heating system at proper low pressures and competent supervision by the rental company. Proper selection of heating equipment *and proper use*—these are both essentials of heating economy.

Are You Planning a 194? Hotel Bellerive?

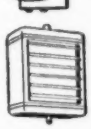
In 1922, the logical choice was a Webster Vacuum System with Webster Traps on radiators and drip points.

Today the choice would be a "Controlled-by-the-Weather" Webster Moderator System with:

(1) Webster Outdoor Thermostat Control automatically assuring the lowest possible pressure consistent with comfort;

(2) Webster System Radiation — concealed convectors made of copper tubing and aluminum fins, with *integral* Webster Traps and Valves;

(3) Webster Float and Thermostatic Drip Traps on heating coils of air conditioners and drip points of the piping system;



(4) Webster-Nesbitt Unit Heaters for garage space and similar heating zones.

Let Webster experience serve you.

WARREN WEBSTER & CO., Camden, N. J.
Representatives in principal U. S. Cities : : Est. 1888
In Canada, Darling Brothers, Limited, Montreal

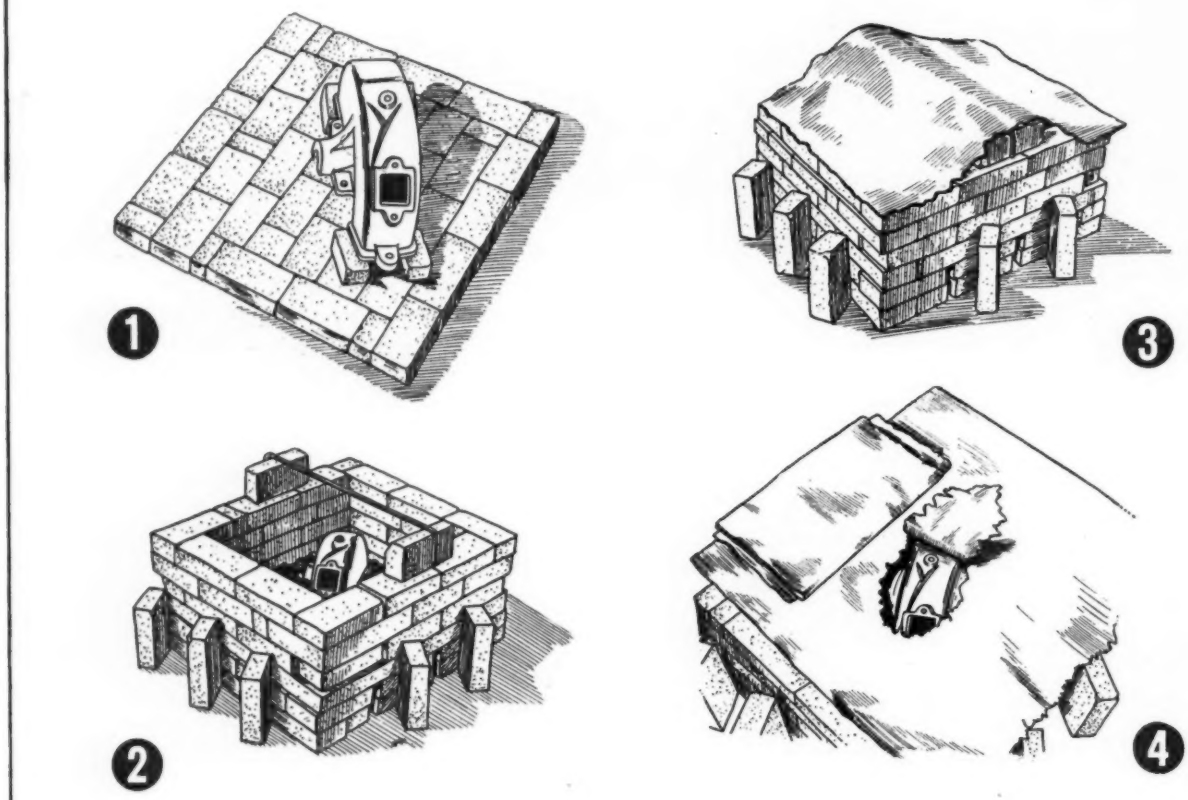
Webster
Heating Systems

HOW TO CONSTRUCT A PREHEAT FURNACE

▶ BEST WAY to preheat a metal object for welding or annealing is to put it in an easily erected charcoal-fired furnace. Advantage is that furnace can be built to fit the job. Charcoal is best fuel because it produces steady, constant temperature, gives off no smoke, and does not require forced draft. Coke produces too high a temperature and gives localized heating.

When preparing the apparatus for use, put a layer of fuel on the furnace bottom. Position the object on its supports and then strew additional charcoal around the thicker metal sections. Once the fire is started, regulate it closely so the part heats uniformly. After the fire burns for half an hour check the casting to prevent overheating. Most accurate way to do this is with temperature-indicating crayons. If these are not available, a splint of soft pine can be rubbed against the casting; if the wood chars, the part is ready for welding. A more accurate test is to make a button from lead, and place it on the casting. Melting indicates a temperature of about 600 F, which is the desired preheat for ordinary cast iron.

After welding is completed, close the flap and stand bricks in front of draft openings. Permit the fire to die out and the casting to cool before removing it from the furnace. Slow cooling is necessary to prevent further cracking. *Courtesy of The Linde Air Products Co*



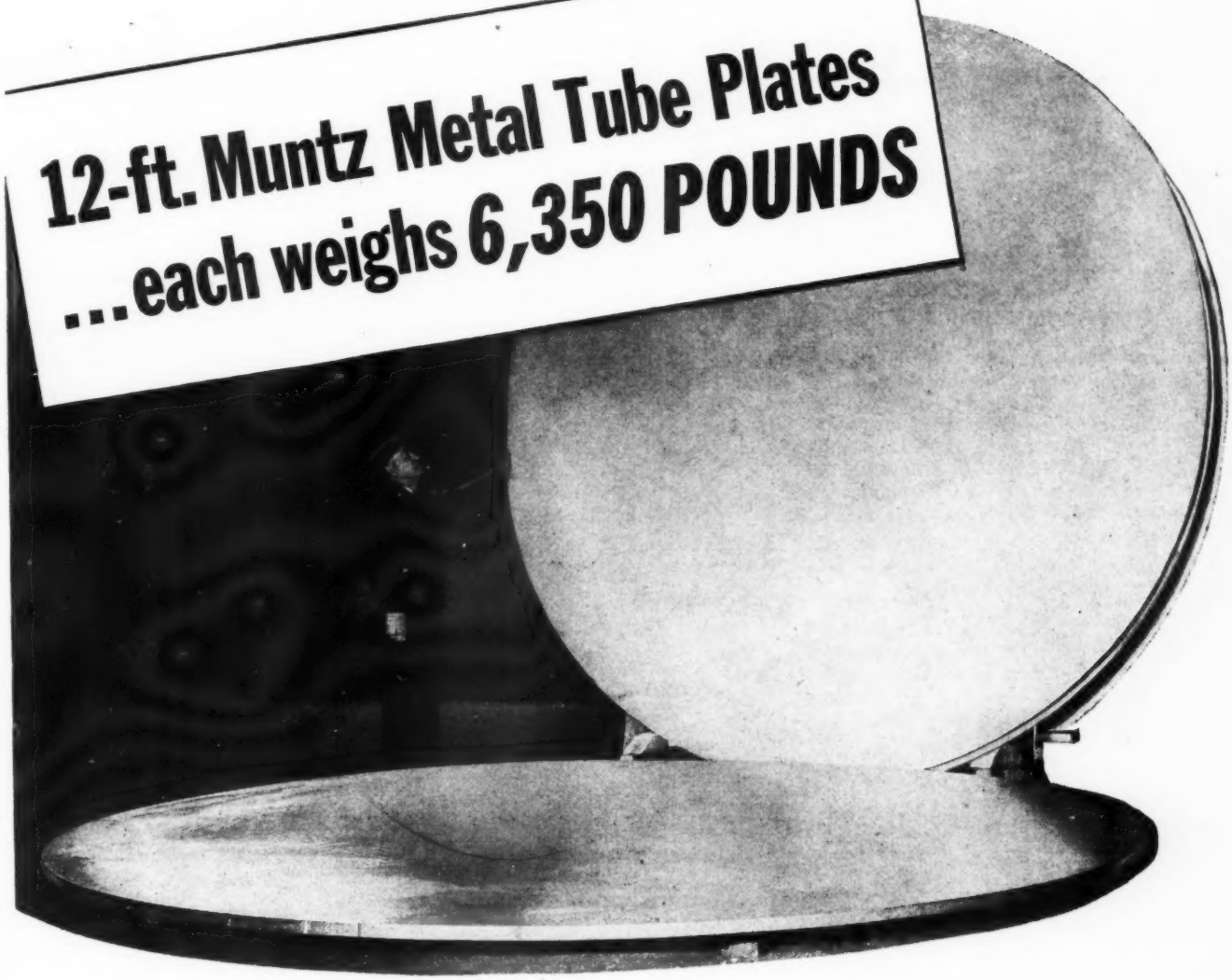
1 Spread layer of sand on brick, concrete, steel or earth floor. Lay firebrick close together on sand to form furnace floor. Put several bricks on the floor to elevate the object and keep it in position so it does not tilt or wobble during welding operations

2 Erect firebrick walls, leaving 2-in. space between bricks in first course. Build walls higher than piece to be heated. After covering floor with charcoal, place casting on its firebrick supports; add more charcoal around thicker portions. Insert torch in draft openings to light fire. Lay a bar across two additional bricks to support the roof. These can be removed and the roof be made flat before welding

3 Lay asbestos paper over crossbar to form roof; use extra bricks to regulate air inlet as needed. If necessary, apply compressed air at each of the lower draft openings to get the fire burning evenly

4 If the part is to be welded, tear a flaplike break in the asbestos cover to expose weld area. Additional layers of asbestos laid across furnace top protect the welder against the intense heat of fire

12-ft. Muntz Metal Tube Plates ...each weighs 6,350 POUNDS



THESE TWO unusually large special shaped, hot rolled Anaconda Muntz Metal Tube Plates were produced at The American Brass Company's Detroit Branch. Each weighs 6,350 lb., is 148″ in longer dimension, and 139″ wide.

Through its various plants, this Company manufactures a widely diversified line of plates and circles for marine and stationary condensers, refinery and other process condensers and heat exchangers, feed water heaters and oil coolers.

During the entire course of production, this material is subject to close technical supervision and control. Thus, Anaconda Plates and Circles are accurately alloyed, commercially flat, true to dimensions, readily machined, and unsurpassed in soundness and close-grained structure.

Anaconda Condenser Tube Sheets and Plates are made in several copper alloys in widths up to 157″, circular plates up to 160″ diameter. When specifications call for extremely large plates for special applications, we will gladly cooperate in the solution of such problems . . . as evidenced by the plates illustrated above. 40177

ANACONDA

Anaconda

COPPER & COPPER ALLOYS

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD.
New Toronto, Ont.

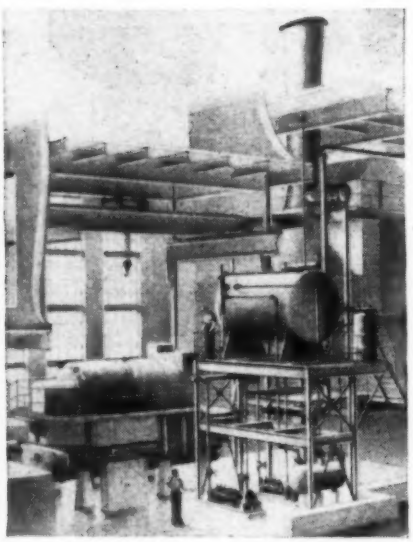
WHAT'S New IN PLANT EQUIPMENT

Condensate Booster

HIGH-PRESSURE CONDENSATE UNIT has improved design. A close coupling eliminates the pump outboard-shaft bearing and a silent hydraulic jet permits more convenient installation because pump noise is no longer a factor. A larger pump, driven by a 25-hp motor, has been added to handle capacities previously impossible with smaller units. **Dept P, Cochrane Corp, 17th St & Allegheny Ave, Philadelphia 32, Pa.**

Tungsten-Carbide Balls

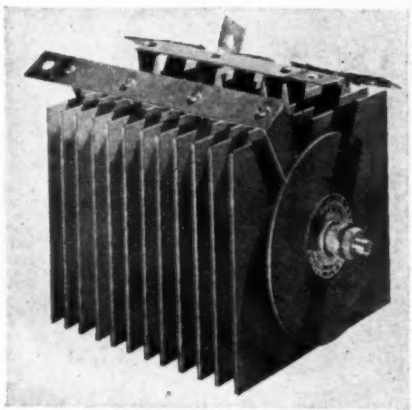
PRECISION BALLS of tungsten carbide are now available. Their hardness, in combination with corrosion resistance, makes them useful in check valves and for special bearings and anti-friction mountings. **Dept P, Industrial Tectonics, Ann Arbor, Michigan.**



Standard Power Plant

COMPLETELY EQUIPPED 5000-KW power plant developed for war devastated areas is now available for peacetime applications. Unit contains 75,000-lb-per-hr 450-psi 760-F steam generator, a 6250-kw 3600-rpm turbine-generator, duplicate boiler-feed pumps (one motor- and one turbine-driven) wiring, piping and other essentials for plants.

There is a choice of two firing methods: (1) Coal-fired unit employs spreader stoker with traveling grate and economizer for stated boiler efficiency of 83% even with lignite. (2) Oil-burning installation has an air preheater and is reported to operate at 85% boiler efficiency. **Dept P, Westinghouse Electric Corp, Pittsburgh 30, Pennsylvania.**



Selenium Rectifier

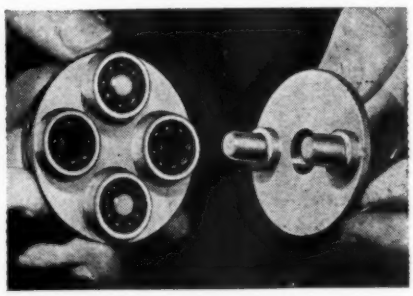
BUILT ON ALUMINUM and developed specifically for high-current capacity, this selenium rectifier is especially applicable for electroplating and battery charging. These two 5x5¾-in. plates feature long life and minimum weight with maximum heat-dissipating capacity. **Dept P, Radio Receptor Co, Inc, 251 W 19th St, New York 11, N. Y.**

Four-Pole Multibreaker

THIS 4-CIRCUIT MULTIBREAKER offers in one unit both thermal and high-speed magnetic tripping. This unit, *Model MO-4*, carries both starting and warming-up loads of power and lighting circuits, and offers fast protection by magnetic tripping action when heavy overloads or short circuits occur.

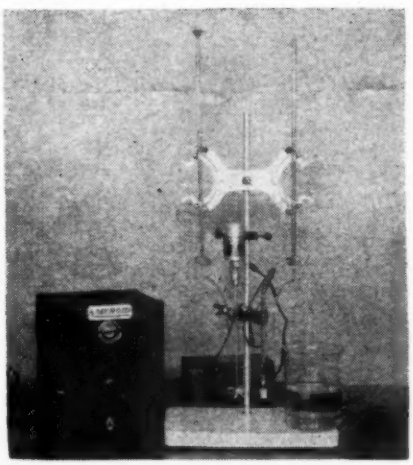
Designed especially to meet heavy demand for multibreakers for low-cost housing and as load centers in farm electrification, the *MO-4* offers branch circuit capacities of 15, 20 and 30 amp. Two single-pole breakers can be easily converted through a double-pole breaker for 3-wire circuits. Handle clearly indicates *on*, *off*, and *tripped* positions. A simple movement of the handle restores current to the circuit after it opens on short circuit.

No live parts are exposed, and the unit contains no coils that burn out. All units are tamperproof, and are approved by both Underwriters' Laboratories, Inc, and the 1946 National Electrical Code. **Dept P, Switch and Handle Division of Square D Co, 6060 Rivard St, Detroit, Mich.**



Small Flexible Couplings

MORFLEX COUPLINGS, designed for low power takeoff of fractional-horsepower drives, are available in two new sizes, 3- and 9-ftlb torque. They weigh about ½ and 1¼ lb respectively. Maximum speed is 3600 rpm for both sizes. Stock bores range from ¼ in. on smaller unit to 1 in. on larger size. Couplings are unaffected by oil, dirt or weather, and require no lubrication. **Dept P, Morse Chain Co, Detroit, Mich.**



Dissolved Oxygen in Water

CORROSION OF POWER-PLANT EQUIPMENT by water containing dissolved oxygen is a common experience. To insure against an objectionable amount, method for determining dissolved oxygen must be accurate.

Winkler method is basis for all modern tests, but use of starch as an indicator gives questionable results and it is also

POWER brings this monthly survey of new equipment as one of its many reader services. In requesting additional information from manufacturers, please identify the source of your inquiry by referring to Dept. P.

No Limit on Standardization in Power Piping Equipment

ONE SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

To central stations and industrial power plants of today and tomorrow, Crane has a lot to offer. Now, when you're planning to rebuild or expand, count on the complete Crane line to help speed and simplify every step of piping procedures—from design to erection to maintenance.

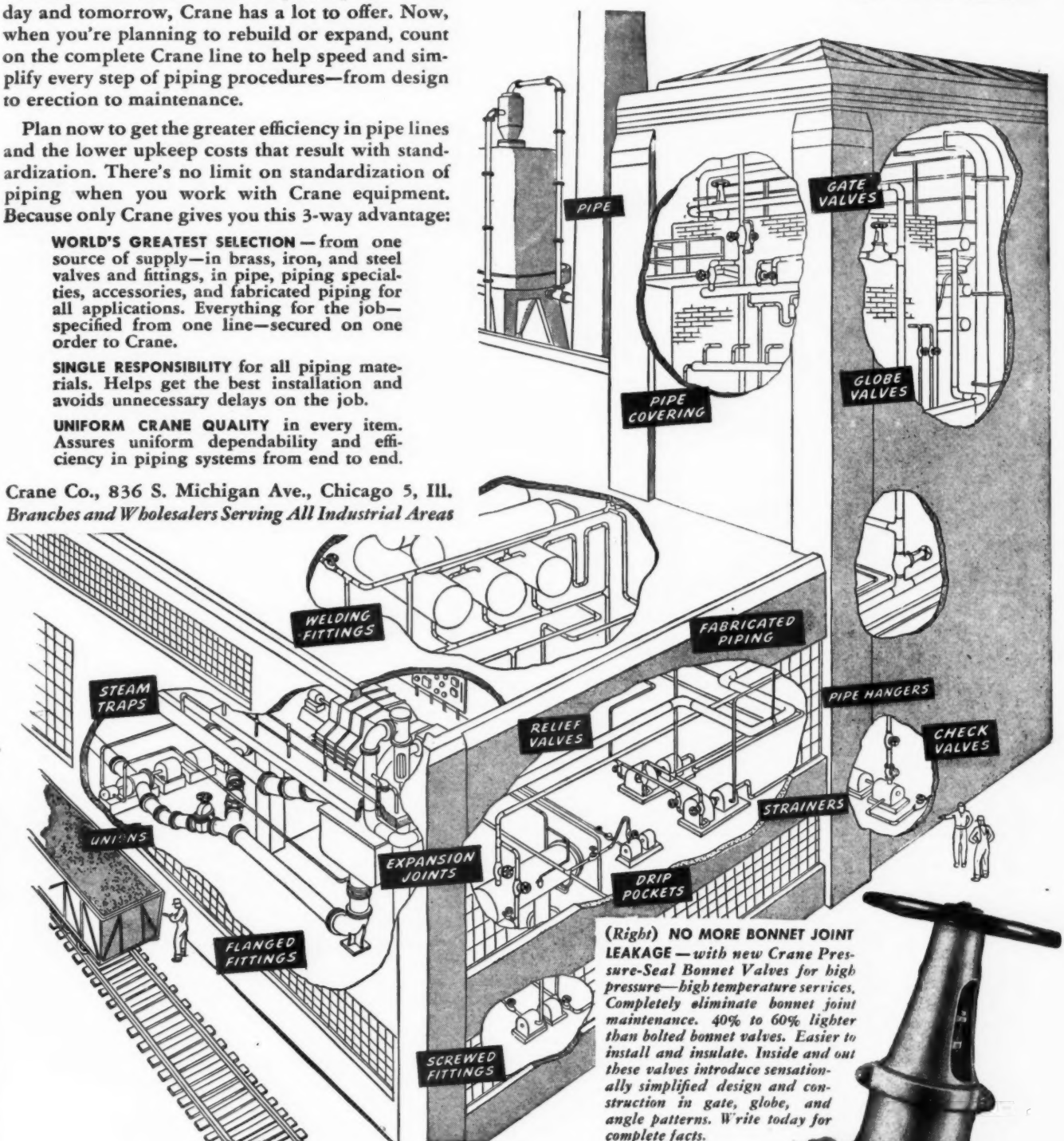
Plan now to get the greater efficiency in pipe lines and the lower upkeep costs that result with standardization. There's no limit on standardization of piping when you work with Crane equipment. Because only Crane gives you this 3-way advantage:

WORLD'S GREATEST SELECTION — from one source of supply—in brass, iron, and steel valves and fittings, in pipe, piping specialties, accessories, and fabricated piping for all applications. Everything for the job—specified from one line—secured on one order to Crane.

SINGLE RESPONSIBILITY for all piping materials. Helps get the best installation and avoids unnecessary delays on the job.

UNIFORM CRANE QUALITY in every item. Assures uniform dependability and efficiency in piping systems from end to end.

Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas



(*Right*) **NO MORE BONNET JOINT LEAKAGE** — *with new Crane Pressure-Seal Bonnet Valves for high pressure—high temperature services. Completely eliminate bonnet joint maintenance. 40% to 60% lighter than bolted bonnet valves. Easier to install and insulate. Inside and out these valves introduce sensationally simplified design and construction in gate, globe, and angle patterns. Write today for complete facts.*

EVERYTHING FROM . . .

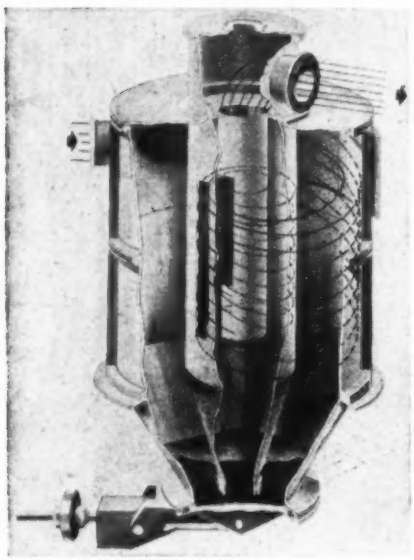
VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

CRANE

FOR EVERY PIPING SYSTEM

difficult to determine endpoint. Several modifications have increased the accuracy of this test. One favorable method is based on the article by Ulmer, Reynar & Decker in *ASTM Proceedings*, Vol 43, 1943, p 1258. This method corrects for impurities in the water and the apparatus uses a "magic eye" type of endpoint instead of starch. At the exact endpoint, one drop of the titrating solution (0.002 N) causes the eye to blink closed. There is no question as to when the endpoint is reached, no graphs or curves to draw, as with potentiometric titration.

A test kit is complete with instructions. **Dept P, Industrial Dept, E F Drew & Co, 15 E 26th St, New York, N. Y.**

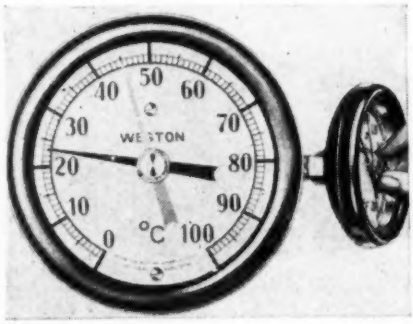


Ash Receiver and Separator

CYCLONE-CONSTRUCTION 3-cone receiver separates ash and dust from an air stream under vacuum. Incoming air and ash drawn by a steam-exhauster impinge against a removable, heavy-duty plate and proceed under a whirling motion into two successively smaller cylinders. Centrifugal force throws out entrained ash and it settles on a roller-bearing hinged gate held in place by vacuum during operation. Air exhausts through a pipe on top of receiver. Weight of collected ash trips hinged gate during intermittent "off" periods. **Dept P, Beaumont Birch Co, Philadelphia, Pa.**

Oxygen Indicator

A GAS DETECTOR measures oxygen content of gaseous mixtures in combustion control as well as in chemical, metallurgical, petroleum and allied industries. Detector is also useful in controlling pipeline corrosion. Device contains a polarized electrolytic cell containing a hollow carbon pole. Gas sample passes through hollow-carbon electrode and any oxygen present combines with the electrolytic hydrogen bubbles. This lowers cell's internal resistance and increases its current and voltage output. A direct-reading meter indicates percentage of oxygen present. **Dept P, Mine Safety Appliance Co, Braddock, Thomas & Meade St, Pittsburgh 8, Pa.**



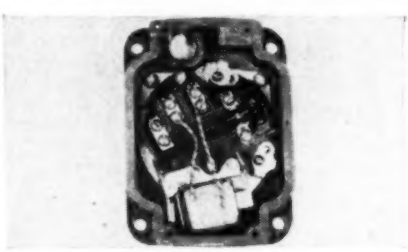
Dial Thermometer

AN ALL-METAL THERMOMETER has an auxiliary red index pointer, which can be manually set on high or low side of main pointer. The latter moves the index to maximum or minimum temperature reached, and leaves it at that position. Instrument is available with either 3- or 5-in. scales and 2½- to 48-in. stems. **Dept P, Weston Electrical Instrument Corp, Newark, New Jersey.**

Plugging Switch

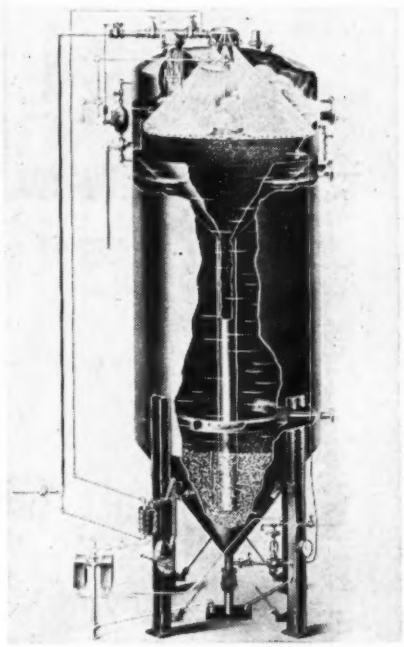
OIL-TYPE AND DUSTPROOF plugging switches for flange and service mounting remove plugging power from a motor at the right moment to keep it from restarting in reverse direction. Flange-mounted types are for built-in application, and surface-mounted for general use.

Contacts are silver, and handle coil current of 150-amp contactor. This eliminates interlocking relays on starting panels. Wiping action, which results from a spring-bound contact strip, keeps contact surfaces clean. Speed is easily adjusted by changing tension of two springs with a screwdriver. An *Alnico* magnet provides the forces for operating the contact without using frictional parts. Operating shaft and magnet have ball bearings.



An extra lockout device releases lockout latch and permits thermal operation of switch when motor is connected to line. This device also protects operator by acting as a guard against accidental starting when he turns the machine over by hand.

Maximum continuous rotating speed of new switch is 1800 rpm. Two sizes of springs provide adjustment of contact operating-speed range from 40 to 140 rpm, and 140 to 750 rpm. **Dept P, General Electric Co, Schenectady 5, N. Y.**



Hot-Process Softener

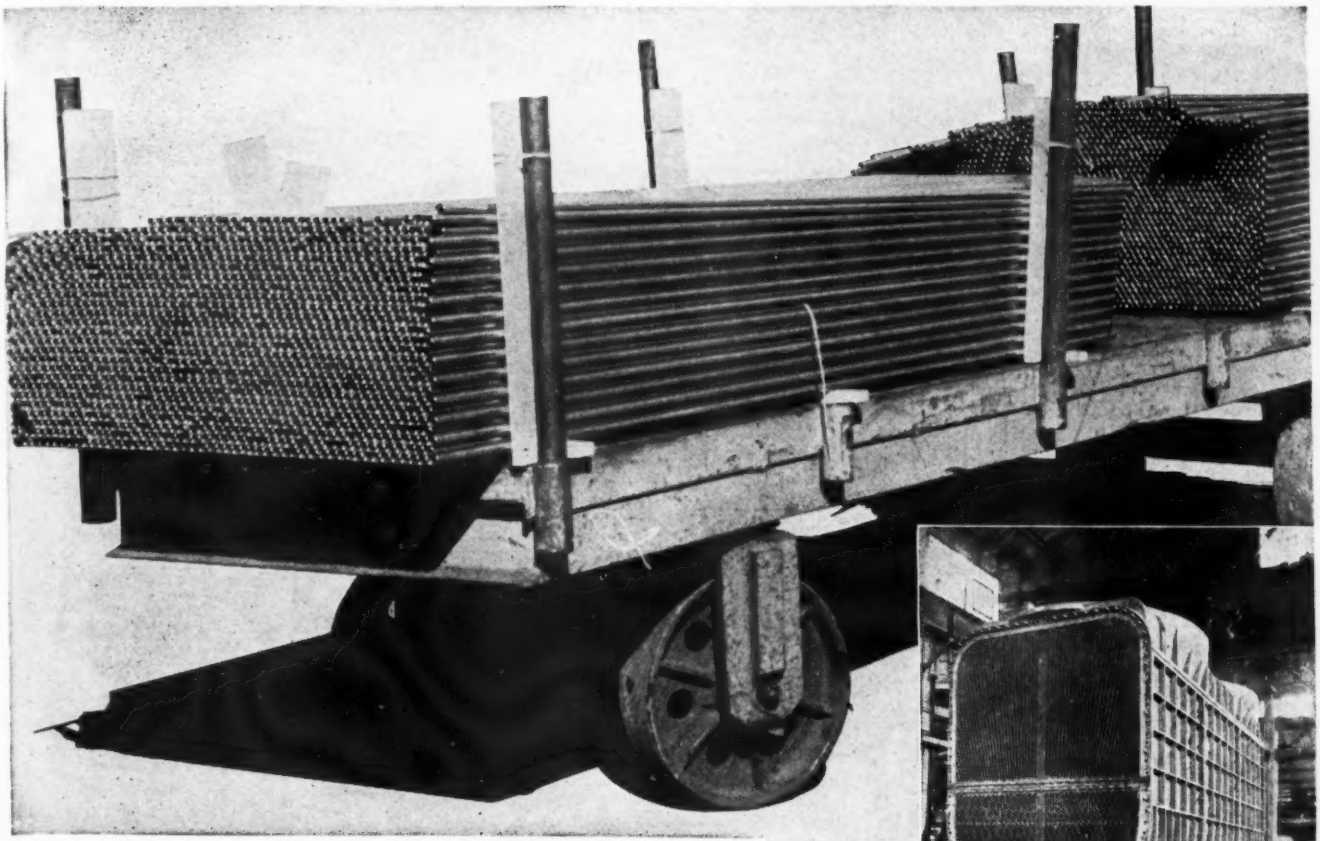
IMPROVED SOFTENER uses a sludge blanket that screens out fine particles to produce an effluent of low turbidity. Thus load on filter beds is lower. Manufacturer claims a considerable saving in chemicals needed to produce good boiler feedwater. When sludge blanket contains much oxide or hydroxide, new unit removes silica to a high degree.

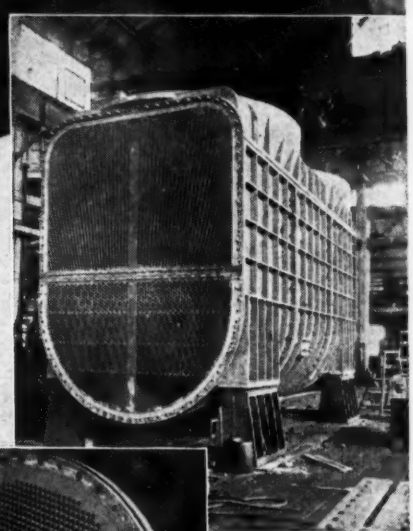
An automatic desludging valve, actuated by an electronic turbidity detector, which continuously measures a water sample passing through the bed, controls sludge-bed depth. **Dept P, Permutit Co, 330 W 42nd St, New York 18, N. Y.**

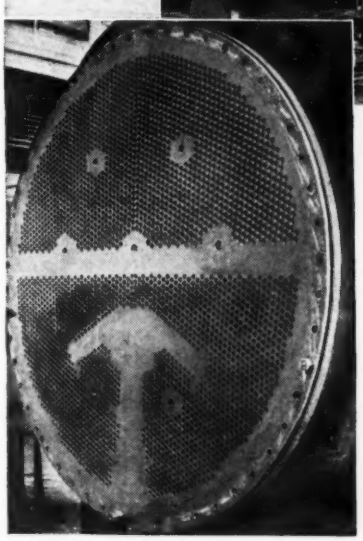
High-Vacuum Oils

DIFFUSION PUMP SILICONE OILS, *DC* 702 and *DC* 703, produce extremely high vacuum and withstand exposure to air and moisture at operating temperatures without appre-

POWER brings this monthly survey of new equipment as one of its many reader services. In requesting additional information from manufacturers, please identify the source of your inquiry by referring to Dept. P.







Easy machinability is one of the important features of Revere Condenser Tube Plates.

See REVERE

for Condenser Tubes and Plates

FOR many years Revere has been a prime source of supply for tubes and plates needed in the power, chemical and marine fields for condensers, heat exchangers, and similiar uses.

Today, Revere once again is able to accept unrestricted orders.

Plates are offered in the following: Muntz Metal, Naval Brass, Herculoy (silicon bronze), Cupro-Nickel, Admiralty Metal, Copper.

Tubes: Muntz Metal, Admiralty Metal, Copper, Revalon (aluminum brass), Cupro-Nickel, Herculoy, Brass.

Plates are offered in squares, rectangles, circles, half-circles, segments, and special patterns, up to 120 inches maximum dimension, finished weight about 11,000 lbs. maximum. These plates are flat, dense, free from blow holes and surface imperfections, accurate in gauge.

Revere tubes are available in all conventional sizes and gauges, and are made by the extrusion process, which produces dense, uniform and highly corrosion-resistant tubes.

Revere is glad to cooperate with you in determining the best alloy for any given conditions of use.

REVERE

COPPER AND BRASS INCORPORATED

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• • •

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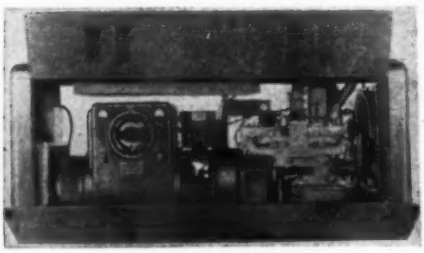
ciable decomposition. They are used in electron microscopes, metal evaporator systems, production of vacuum tubes, and dehydration of foods and pharmaceuticals.

Advantages are: extremely low vapor pressure, rapid recovery after exposure to atmosphere at operating temperatures, freedom from decomposition and fouling of heater surfaces, and improved performance of fore-pump. **Dept P, Dow-Corning Corp, Midland, Mich.**

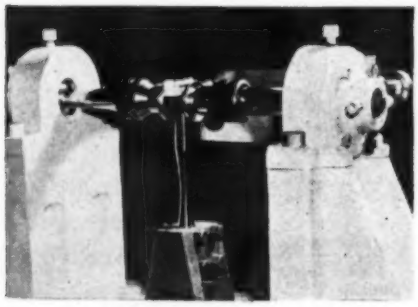


Gas-Electric Arc-Welder

UNIT CONSISTS OF A 300-AMP GENERATOR and 20-hp motor mounted on a shaft that is coupled to a 6-cylinder gasoline engine. A free-wheeling clutch automatically disengages the engine when electric motor functions. Motor is wound for dual voltage (220/440), and changeover is accomplished by manipulating a double-throw switch. **Dept P, Hobart Brothers Co, Troy, Ohio.**

Fatigue Machine

TEST INSTRUMENT FATIGUES PARTS, such as turbine buckets, small assemblies, and test specimens by reverse bending. Machine uses a pneumatic resonant principle and vibrates test specimen at its own resonant frequency, thus closely simulating actual dynamic-load conditions. Machine is one basic unit consisting of a fatigue motor. An optional accessory panel provides recording and direct reading of displacement, frequency and temperature of specimen. It also provides automatic shutdown upon specimen failure. Another optional feature is a furnace, which permits testing at temperatures up to 1700 F. A microscope and vibrating-type reed frequency meter are furnished as standard equipment for direct reading of displacement and frequency. **Dept P, Special Products Div, General Electric Co, Schenectady 5, N. Y.**



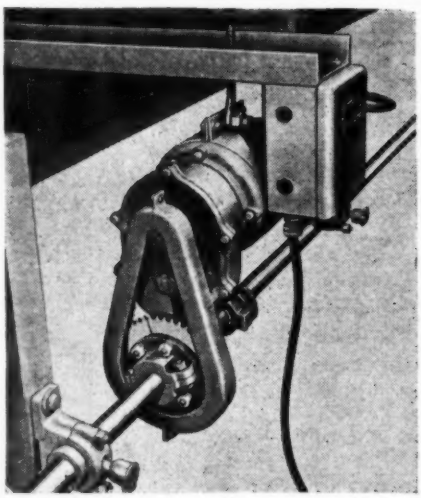
Rotating Lathe Center

SPINDLE OF THIS CENTER rides on self-contained preloaded roller bearings. Eccentricity or run-out of the point is held to 0.0002 in., both free and under load. Sturdy construction permits operation at high machine speed. **Dept P, Holub Industries, Inc, Sycamore, Ill.**

Power Travel for Cranes

TRAVELATOR PROVIDES ELECTRIC-POWER travel for hand-traveled overhead cranes. Universal mounting makes it applicable to any overhead crane, both single and double girder. Driving motor is held in steel band connected to mounting bracket. Band holds motor in any desired position about square shaft that it drives.

Crane applications are: deep-beam top-running, shallow-beam top-running, beam deeply notched into end truck, exceptionally shallow-beam top-running, shallow-beam underhung, and double-girder. **Dept P, Northern Engrg Works, 2615 Atwater St, Detroit 7, Mich.**

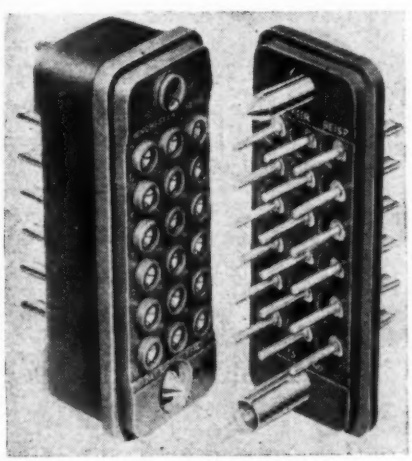


Brush for Small Tubes

AN EXPANDING BRUSH removes light scales and deposits from tubes as small as ¼ in. ID in heat exchangers, evaporators, condensers and similar equipment. Unit is rotated mechanically by an air, steam or water turbine, or an electric motor through a flexible shaft. Brush cartridges are available with tempered-steel, stainless-steel, copper wire, nylon, tampico-fiber or pig bristles. **Dept P, Thomas C Wilson, 21-11 44th Ave, Long Island City 1, New York.**

Large-Sized Screw Lug

THE KPA 34, a large-sized screw lug, accommodates a range of wire and cable sizes from 4/0 wire to 500 Mcm cable. This lug is quickly installed by simply tightening clamping bolt, which forces a pressure bar against cable. It is formed from pure copper, brazed for additional mechanical strength, conductivity and pull-out value. Manufacturer claims performance of the screw lug greatly exceeds the Underwriters' Laboratories, Inc, requirements. **Dept P, Burndy Engrg Co, 107 Bruckner Blvd, New York 54, N. Y.**



Monoblock Connector

MULTI-CONTACT CONNECTOR BLOCK fits easily in limited space. Connector is supplied with a self-contained locking device, which eliminates external clamps.

Molded in plastic, the one-piece inserts

(*Continued on page* 172)

POWER brings this monthly survey of new equipment as one of its many reader services. In requesting additional information from manufacturers, please identify the source of your inquiry by referring to Dept. P.

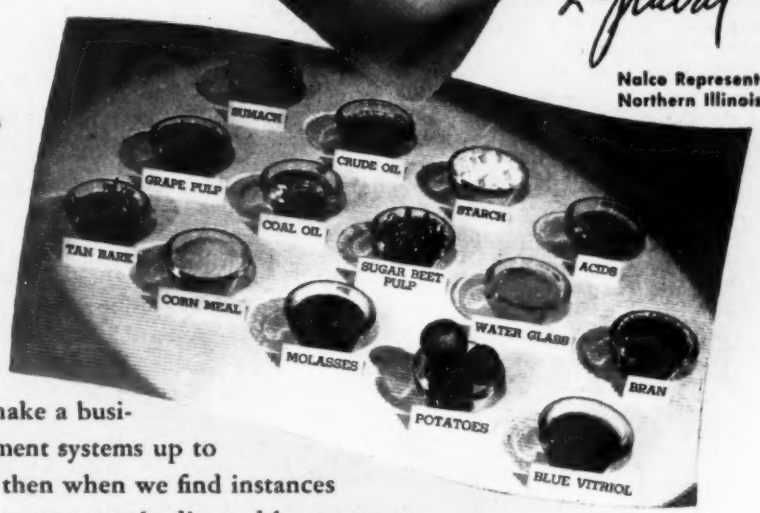
Hard to believe...

. . . but some water treatments are still based on Rumor and Folklore

says:

L. Flubral

Nalco Representative
Northern Illinois



Some of the Folklore Water Treatments

Only a few of the strange materials Nalco engineers have found being used as boiler water treatments are shown here. Some are partially effective . . . Others are actually dangerous.

EVEN those of us who make a business of bringing water treatment systems up to date get a surprise now and then when we find instances where the water treatment was apparently dictated by rumor or folklore, or both. Putting the Nalco System to work in such a plant is usually spectacular . . . Simply because of the vast improvement in boiler and general plant performance. And this difference, in varying degrees, is usually apparent when the Nalco System begins to operate in any plant.

A Nalco survey and recommendations (if necessary) for complete, scientific water treatment in your plant will cost you nothing—may be the means of substantial savings in overall plant operating costs. Write today for complete information.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to
Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario

nalco

The Scientific Water Treatment for All Industry

How to plan a

DIESEL ENGINE COOLING WATER CIRCUIT WITH WASTE HEAT RECOVERY

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

Waste heat can be recovered with this type circuit in small plant installations like garages, restaurants and laundries, where Diesels are used for generating electricity. Heat in the cooling water is dissipated through a unit heater and also through an exchanger for domestic hot water supply. When not required for heating, the airflow from the unit heater can be directed into a vent. This is controlled by a thermostatically operated damper responsive to room temperature. The amount of heat dissipated in the unit heater and in hot water generation can be balanced by globe valves provided. An aquastat shuts off unit heater fan should water temperature fall below the desired value. Hence, if hot water demand uses all waste heat, the unit heater will cease to function.

Emergency operation means is provided by a temperature and pressure relief valve, should the unit heater and the water heating circuit fail to cool the water sufficiently or should either of these devices be out of service. If excess temperatures or pressures develop, these valves will open and the pressure reducing valve will automatically admit cold city water to replace water relieved. A manual bleed is provided. If the hot water and unit heater demand is too great, over cooling is prevented by a modulating valve which will by-pass a portion of the cooling water directly back to the circulating pump.

The admission of city water through the pump suction guards against low city water pressures which might prevent automatic admission of water. Drains and air vents are provided to permit shutdown for maintenance and freeing air from the system.

All valves shown are bronze. A large size shutoff valve, Fig. 677-A, is recommended for city water be-

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A **Use the right type valve for the service.**
B **Place valves correctly in the line.**
C **Choose Jenkins Valves for lifetime economy.**

16

Fig. 106-A
Renewable Composition Disc Bronze Globe Valve
150 Pounds Steam
300 Pounds O.W.G.

cause of its extreme importance in case of water line breaks or other emergencies.

Other types and pressure ranges of Jenkins Valves can be used for this type of layout, according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

Copies of Layout No. 16 will be furnished on request . . . also copies of future Piping Layouts. Just fill out and mail the coupon.

Fig. 106A, a Renewable Disc Bronze Globe Valve, is designed with a convenient slip-on, stay-on disc holder that permits a quick change of disc. The resilient composition disc assures drop tight closure with the least closing effort. The sturdy screwover bonnet is unaffected by repeated disassembly and reassembly. Many other unusual features, described in Jenkins Catalog, make Fig. 106A one of the most widely used of all Jenkins Valves.

A CHOICE OF OVER 600 JENKINS VALVES

To save time, to simplify planning, to get the advantage of Jenkins specialized valve engineering experience, – select all the valves you need from the Jenkins line, fully described in the Jenkins Catalog, No. 76. It's your best assurance of *the lowest cost in the long run.*

Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta, Boston, Philadelphia, Chicago, San Francisco. Jenkins Bros., Ltd., Montreal; London, England.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK
SINCE 1864

TRADE JENKINS MARK

125 TO 600 LBS. STEAM PRESSURE

Jenkins Bros

DIESEL ENGINE COOLING WATER CIRCUIT WITH WASTE HEAT RECOVERY

Diagram by Huxley Madeheim, Consulting Engineer

VALVE RECOMMENDATIONS

For details — and valves to suit varying conditions — see Jenkins Catalog.

Code	Quan.	Jenkins Valves	Service
A	2	Fig. 106-A Bronze Globe	Air Vents and Bleeds
B	9	Fig. 106-A Bronze Globe	Drains
C	1	Fig. 677-A O. S. & Y. Bronze Gate	City Water Shut-off
D	1	Fig. 106-A Bronze Globe	City Water Test Connection
E	1	Fig. 92 Bronze Swing Check	City Water Backflow Prevention
F	3	Fig. 47 Bronze Gate	3-way Mod. Valves Shut-off
G	2	Fig. 106-A Bronze Globe	3-way Mod. Valves By-pass
H	2	Fig. 47 Bronze Gate	P.R.V. Shut-off
I	1	Fig. 106-A Bronze Globe	P.R.V. By-pass
J	1	Fig. 92 Br. Swing Check	Prevention of back-flow into City Water
K	2	Fig. 92 Br. Swing Check	City Water Check-off
L	2	Fig. 106-A Bronze Globe	Heat Exchanger Shut-off Control
M	1	Fig. 106-A Bronze Globe	Heat Exchanger By-pass
N	2	Fig. 106-A Bronze Globe	Unit Air Shut-off and Control
O	1	Fig. 106-A Bronze Globe	Unit Air By-pass
P	1	Fig. 106-A Bronze Globe	System Manual Bleed
Q	1	Fig. 47 Bronze Gate	Pump Suction Shut-off
R	1	Fig. 106-A Bronze Globe	Pump Discharge Shut-off
S	1	Fig. 92 Br. Swing Check	Pump Discharge Check
T	1	Fig. 106-A Bronze Globe	Floor Drain Trap Fill
U	1	Fig. 47 Bronze Gate	Hot Water Tank Shut-off
V	4	Fig. 106-A Bronze Globe	Engine Cooling Water Control
W	1	Fig. 106-A Bronze Globe	Cold Water Supply
X	1	Fig. 47 Bronze Gate	Cold Water to Heat Exchanger

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Please send me a reprint of Piping Layout No. 16 and future Layouts as they become available.

Name.....

Company.....

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Number 171

Speeds With Standard Pulleys: II

SPEEDS WITH 850-RPM MOTORS: *Driver- and Driven-Pulley Diameters in Inches*

PULLEYS, DIA: DRIVER, IN.	3	3½	4	4½	5	5½	6	7	8	9	10	11	12	13	14	15	16	17
DRIVEN, IN.	Speed of driven shaft, rpm																	
3	850																	
3½	729	850																
4	638	744	850															
4½	567	661	756	850														
5	510	595	680	765	850													
5½	464	541	618	695	773	850												
6	425	496	567	638	708	779	850											
7	364	425	486	546	607	668	729	850										
8	319	372	425	478	531	584	638	744	850									
9	283	331	378	425	472	519	567	661	756	850								
10	255	298	340	383	425	468	510	595	680	765	850							
11	232	270	309	348	386	425	464	541	618	695	773	850						
12	212	248	283	319	354	390	425	496	567	638	708	779	850					
13	196	229	262	294	327	360	392	458	523	588	654	719	785	850				
14	182	213	243	273	304	334	364	425	486	546	607	668	729	789	850			
15	170	198	227	255	283	312	340	397	453	510	567	623	680	737	793	850		
16	159	186	213	239	266	292	319	372	425	478	531	584	639	691	744	797	850	
18	142	165	189	213	236	260	283	331	378	425	472	519	567	614	661	708	756	803
20		149	170	191	213	234	255	298	340	383	425	468	510	553	595	638	680	723
22		135	155	174	193	213	232	270	309	348	386	425	464	502	541	580	618	657
24			142	159	177	195	213	248	283	319	354	390	425	460	496	531	567	602
26				147	163	180	196	229	262	294	327	360	392	425	458	490	523	556
28				137	152	167	182	213	243	273	304	334	364	395	425	455	486	516
30					142	156	170	198	227	255	283	312	340	368	397	425	453	482
36						130	142	165	189	213	236	260	283	307	331	354	378	401
42							121	142	162	182	202	223	243	263	283	304	324	344
48									142	159	177	195	213	231	248	266	283	301
54										142	157	173	189	205	220	236	252	268
60											142	156	170	184	198	213	227	241
66												142	155	167	181	193	206	219
72													142	153	165	177	189	201
78														139	152	163	174	185
84															142	152	162	172
90																142	151	161
96																	142	151
102																		141

Example: To find the speed of a driven-shaft pulley with a 22-in. pulley belted to a 10-in. pulley on the shaft of an 850-rpm. motor (1) locate the 10-in. column in the 850-rpm. table and (2) find the intersection with the 22-in. horizontal line which reads 386 rpm

SPEEDS WITH 690-RPM MOTORS

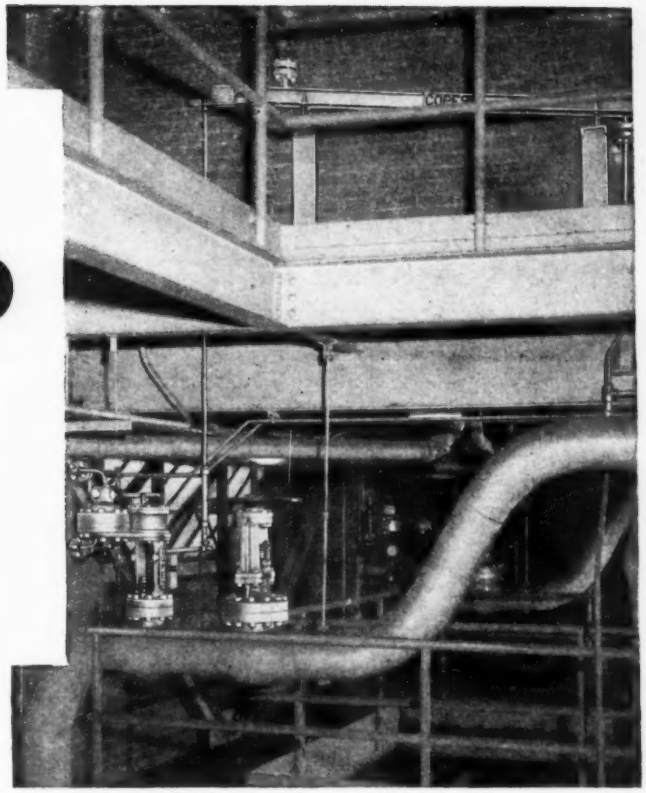
PULLEYS, DIA: DRIVER, IN.	8	9	10	11	12	13	14	15	16	17	18
DRIVEN, IN.	Speed of driven shaft, rpm										
8	690										
9	613	690									
10	552	621	690								
11	502	565	627	690							
12	460	518	575	633	690						
13	425	478	531	584	637	690					
14	394	444	493	542	591	641	690				
15	368	414	460	506	552	598	644	690			
16	345	388	431	474	515	561	604	647	690		
18	307	345	383	422	460	498	537	575	613	652	690
20	276	311	345	380	414	449	483	518	552	587	621
22	251	282	314	345	376	408	439	470	502	533	565
24	230	259	288	316	345	374	403	431	460	489	518
26	212	239	265	292	318	345	372	398	425	451	478
28	197	222	246	271	295	320	345	370	394	419	444
30	184	207	230	253	276	299	322	345	368	391	414
36	153	173	192	211	230	249	268	288	307	326	345
42	131	148	164	181	197	214	230	246	263	279	296
48	115	129	144	158	173	187	201	216	230	244	260
54		115	128	141	153	166	179	192	204	217	230
60			115	127	138	150	161	173	184	196	207
66				115	125	136	147	157	168	177	188
72					115	125	134	144	153	163	173
78						115	124	132	142	151	159
84							115	123	131	140	148
90								115	123	130	138
96									115	122	130
102										115	122
108											115

SPEEDS WITH 575-RPM MOTORS

PULLEYS, DIA: DRIVER, IN.	11	12	13	14	15	16	17	18
DRIVEN, IN.	Speed of driven shaft, rpm							
11	575							
12	526	575						
13	486	531	575					
14	450	493	534	575				
15	421	460	498	537	575			
16	394	431	467	503	539	575		
18	351	384	415	447	479	511	543	575
20	318	346	373	403	431	460	489	518
22	287	314	349	366	392	418	444	470
24	263	288	311	335	359	383	407	431
26	243	266	287	310	332	354	376	398
28	226	246	266	288	308	329	349	370
30	210	230	249	268	288	307	326	345
36	176	192	208	224	240	256	272	288
42	150	164	178	192	205	219	233	246
48	132	144	155	168	180	192	204	216
54	117	128	138	149	160	170	181	192
60	105	115	124	134	144	153	163	173
66	96	104	113	122	131	139	148	157
72		96	104	112	120	128	136	144
78			96	103	111	118	125	132
84				96	103	110	116	123
90					96	102	109	115
96						96	102	108
102							96	101
108							91	96

Courtesy of American Leather Belting Association's Engineering Committee

BOILER LEVEL HELD ±1/2 inch AT EASTERN UTILITY



WITH no pressure control on the constant-speed, motor-driven centrifugal boiler feed pumps, water level is held within plus-or-minus one-half inch in this 675-psi Erie City boiler in service at an Eastern utility plant. Load changes, over a range from 65,000 to 150,000 pounds of steam per hour, mean marked changes in differential water pressure, but the COPES Flowmatic Regulator *automatically* compensates for such pressure variations.

The COPES Flowmatic is a two-element control, responsive to rate of steam flow and to changes in boiler water level. It is recommended for boilers subject to rapid or wide fluctuations in demands for steam. Direct- or relay-operated, depending on the service conditions, it may also be provided with remote control by air, permitting the control valve to be installed at any desired location with respect to the steam-flow and water-level elements. Independent of all other controls and auxiliaries, it is as *dependable* as the single-element COPES, which has been setting performance standards for more than 33 years. The COPES Flowmatic has now been ordered for more than 1700 plants.

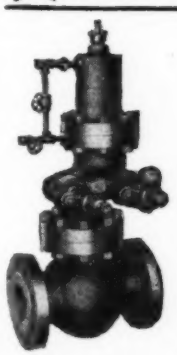
Performance Report, Bulletin 445, tells fully the story of this utility installation of COPES Flowmatic. Illustrated with a sectional drawing of the boiler and charts showing steam flow, feed flow and water level under typical conditions, it should be in your reference file. Write for it.

NORTHERN EQUIPMENT COMPANY
1161 GROVE DRIVE, ERIE 6, PENNSYLVANIA

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS: Canada, England, France. *Representatives Everywhere*

★GET CLOSER LEVEL CONTROL WITH COPES FLOWMATIC

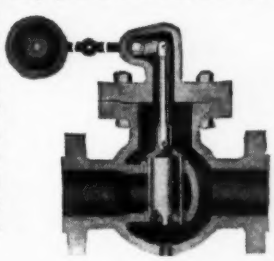


PUMP GOVERNORS

In most installations, especially where the load conditions do not warrant COPES Flowmatic control, good feed water regulation should begin at the boiler feed pumps. *Dependable* excess water pressure control for your feed system, no matter how simple or how demanding your needs, can be provided by COPES engineers. Write—outlining your operating conditions in detail—for their helpful recommendations.

BALANCED VALVES

Many plants have found real savings by paying a few dollars more for COPES Balanced Valves for controlling make-up water to feed water heaters, level in open tanks, evaporator flows and other uses. Control is more accurate with the scientifically-balanced, practically-frictionless COPES. Operation continues satisfactory over a longer service life because of rugged construction. Write for data.



Camp Kilowatts . . .

"Far away, and deep in the bush, where the catch is heavy and the bag is full, Tomorrow's sportsmen will camp in luxury. A wood fire under a 30-pound power unit produces steam in the flash boiler . . . in turn, this runs the turbogenerator which provides electricity for lighting and cooking, as well as charging batteries to run the boat's electric motor . . ."

So opens a current whisky ad in one of the smart magazines. The accompanying drawing shows a pair dressed like electric linemen with a queer box set on stilts over a wood fire. From the box lead at least 50 pounds of heavy cables to a floodlight, a 2-burner electric stove and a pair of batteries. At one side stands a roadster, its built-in 25-horsepower plant unused.

Here is the ad writer in his ivory tower for certain—or far under the influence of the product he's trying to sell! "Deluxe Camping in the Deep, Cool Woods—" Phooey! Here is no flickering firelight and clean wood smell, no crowding shadows and escape from our mechanical world—here is a city apartment in Technicolor lousing up nature.

Why not have the power unit run a pump, radio, waffle iron, mixer, egg beater, electric blanket, movie projector and refrigerator, too? Or more to the point, a saw? Let's have modern man commune with Mother Nature in strictly civilized style—by walkie-talkie. We're reminded of our childhood rainy-day "camping" under the dining-room table with the Sunday tablecloth hanging low.

There is one important point to all this—that any modern concept of complete living seems to involve power. In 50 years a luxury has become such a necessity that we engineers are producing the stuff of which copy writer's dreams are made. No more thoughts of castles and plumed knights, fair maids and fields of honor; now men dream of forest and field, complete with power. Certainly we should study this more closely—rural electrification may be cheaper than power units, or better still, atomic-power capsules in convenient coin-operated dispensers.

So here's to Tomorrow's sportsmen and their outlet boxes on every big tree. If power engineers go back to nature in such a world, it will be like a sailor's holiday—rowing on a lake in a park. Pass the fresh-caught electro-broiled fish.

George Edwards

Engineer

For Insulation Jobs, too

IT HAS TO BE RIGHT THE FIRST TIME

. . . and a first choice of industry for the right insulating job is the Johns-Manville Insulation Applicator

Even the finest insulation must be properly applied to provide top fuel savings and operating efficiency.

The Right Insulation for Every Application

Your J-M Insulation Applicator selects the right materials for your job from the wide variety in the J-M industrial insulation line (for temperatures from 400 F below zero to 2800 F above).

Johns-Manville Insulation specialists, plus the facilities of the J-M Research Laboratory, are available to help you with your particular insulation problems, no matter how complex they may be.

Expert Application of the Right Insulation

J-M Insulation Applicators are a first choice of industry for completely efficient jobs because: (1) They are trained in all phases of insulation application. (2) They employ skilled mechanics and the most up-to-date methods of application.

For further details, write your nearest J-M Insulation Applicator or Johns-Manville, Box 290, New York 16, New York.

JOHNS MANVILLE JM PRODUCTS

JOHNS-MANVILLE *First in* INSULATIONS

FOR THE ENGINEER'S BOOKSHELF

BOOKS REVIEWED IN THIS ISSUE

STANDARD PRACTICES FOR STATIONARY DIESEL ENGINES

GERBER'S AUTOMATIC INTERPOLATING CHARTS

REFRIGERATION THEORY AND APPLICATIONS

WATER TREATMENT AND PURIFICATION

DIESEL ENGINE CATALOG, VOLUME ELEVEN

WATER RESOURCES PAPER NO. 89 • INDUSTRIAL CARBON

Water Purification

WATER TREATMENT AND PURIFICATION (*Revised* 1946) *By William J. Ryan*, 270 *pp*, 5x8, *illust, cloth* $2.75. *McGraw-Hill Book Co, Inc*, 330 *West* 42*nd St, New York* 18, *N. Y.*

The present edition brings the text up to date on the progress made in the water-treatment field since the appearance of the first edition in 1937. The author has supplemented his 17 years' experience in this profession with information contained in various papers presented in the technical press and before engineering societies.

The book is not written for the water-treatment specialist but rather for the engineer who wants a general knowledge of water-purification methods. For the benefit of readers wishing to pursue a more detailed study a selected bibliography is appended to each chapter.

Refrigeration Systems

REFRIGERATION THEORY AND APPLICATIONS (*revised* 1946) *By H G Venemann, Professor of refrigeration, Purdue University*. 336 *pp*, 6x9, *illust, cloth*, $4. *Nickerson & Collins*, 435 *N Waller Ave, Chicago 44, Ill.*

This edition shows considerable physical improvement over the first edition issued in 1942 in that it is printed in conventional style. The text material has been increased to satisfy a demand for coverage adaptable to the normal three-credit-hour college course.

Main purpose of the book is to help the student understand the fundamental principles involved in the processes of mechanical refrigeration, and to enable him to interpret correctly any situations that may arise during the operation of a refrigerating plant.

Included in a pocket are loose-leaf sheets of working pressure-enthalpy charts for air, ammonia, carbon dioxide, methyl chloride, sulphur dioxide and Freon 11, 12, 22 and 113, as well as psychrometric charts for low and normal temperatures of the atmosphere.

Interpolating Charts

GERBER'S AUTOMATIC INTERPOLATING CHARTS. *By F R Gerber. Set of automatic interpolating charts on heavy cardboard*, 8½x11, *round corners, punched for looseleaf notebook, also interpolating tape for use with charts*. $2. *F R Gerber*, 1305 *SW* 12*th Avenue, Portland* 1, *Ore.*

By laying a tape diagonally across carefully ruled parallel lines of the first chart, values corresponding to straight-line interpolation in standard tables may be quickly determined.

Of greater interest to engineers whose work is more technical will be another chart for "graph interpolation" for use with tables corresponding to a curve whose direction is changing rapidly. Other charts are for shortcut, highly precise interpolation when tabular differences are unwieldy and a calculating machine is to be used. Both single and double interpolations are covered in this series of charts.

Nine uncommon reference tables are included: seven aid in computations using angle and time units, and one gives the most useful relations among physical constants. There are also logarithmic and trigonometric tables.

Diesel-Engine Practice

DIESEL ENGINE CATALOG. *Volume* 11. 516 *pp*, 10x13½, *numerous illust, spiral binding, simulated leather*, $10. *Diesel Engines, Inc*, 2 *W* 45 *Street, New York* 19, *New York.*

This current edition of the *Diesel Engine Catalog* presents a cross-section of the engines and accessories available, including a number of designs introduced in the past year. As in previous volumes, the products of each engine builder are described and illustrated, and a summary tabulates the models available, giving cycle, hp, cyl, bore, stroke, rpm, fuel system, starting method, and stating whether engine is suitable for stationary, marine, automotive or portable application. The accessory section, which has been increased in size, covers fuel-injection equipment, superchargers, chain drives, hydraulic couplings, turbochargers, magnetic couplings, flexible couplings, valves, gearing, blowers, clutches, hydraulic transmissions, valve adjusters and injection-nozzle testers.

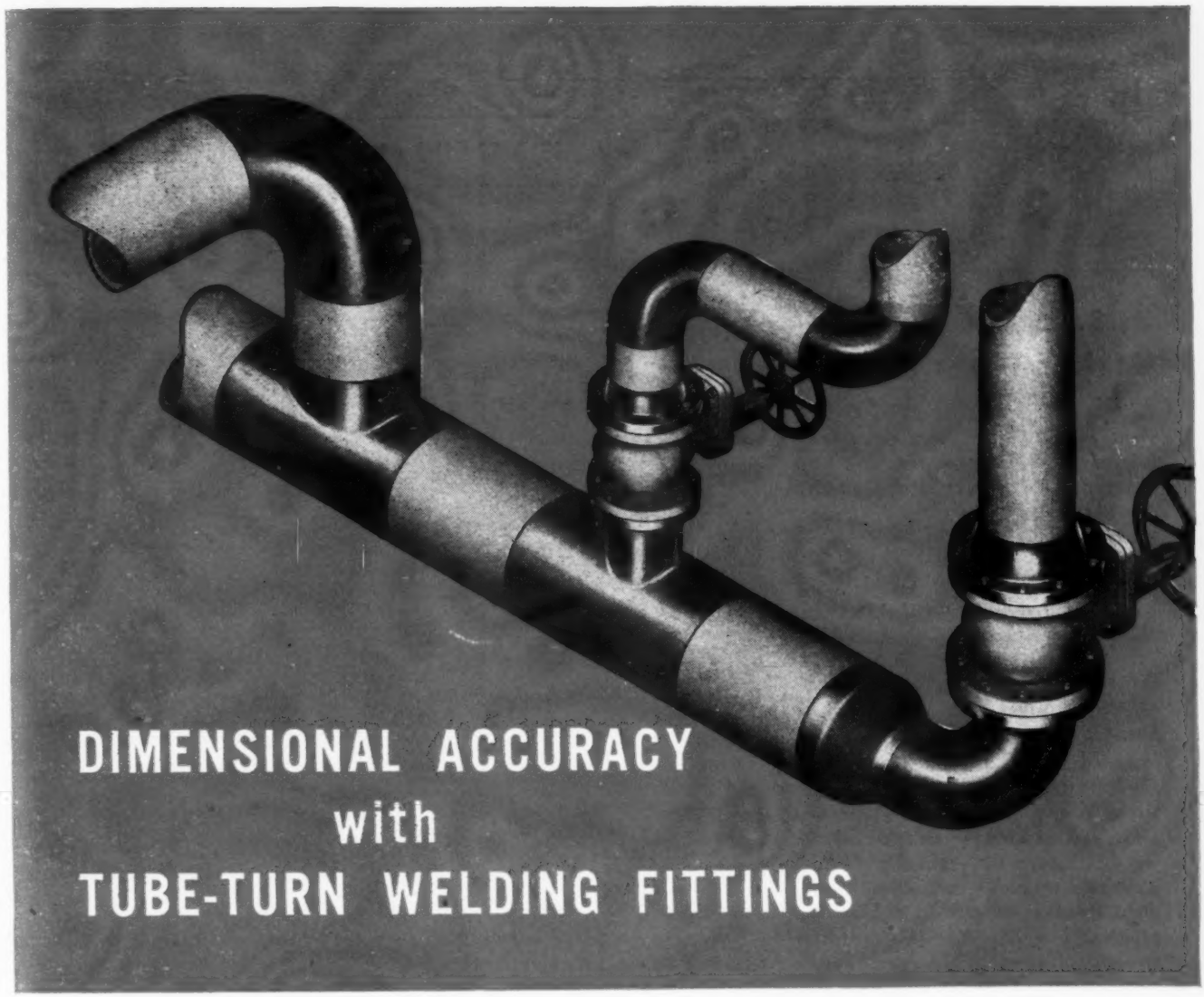
Engineers interested in purchasing diesel equipment and those desirous of surveying progress in the field will find this compilation of engine and accessory designs highly useful, combining, as it does, a great deal of information in a single convenient package.

STANDARD PRACTICES FOR STATIONARY DIESEL ENGINES 3*rd edition*, 157 *pp*, 6x9, *illust, cloth*, $2.50. *Diesel Engine Manufacturers Association, One N LaSalle St, Chicago* 2, *Ill.*

Engineers planning purchase or installation of diesel engines have long found *Standard Practices* of DEMA a highly useful publication. This new edition, covering stationary diesels operating at speeds up to and including approximately 750 rpm, and superseding all previous editions, has been completely revised and new material added.

Starting with chapters on definitions and standard performances and equipment, the new edition goes on to cover engine construction, governors and

(*Continued on page* 150)



DIMENSIONAL ACCURACY with TUBE-TURN WELDING FITTINGS

WHEN pipe and fittings agree in O.D., I.D. and wall thickness, alignment from the *outside* brings them into perfect alignment on the *inside* also. The dimensional accuracy of Tube-Turn welding fittings permits installing any pipe line according to design without making allowances for variations in individual fittings.

All Tube-Turn fittings of the same part number are identical in all dimensions. Quality-controlled Tube-Turn fittings incorporate uniform wall thickness, smooth inner wall and close-knit grain structure. This complete line is available in sizes ranging from one-half inch to 30 inches to meet all your fittings requirements.

Consult your favorite piping authority and see your Tube Turns distributor. For more information on the superiority of Tube Turns' exclusive manufacturing methods and data on successful installations in many industries, write for Catalog 111.

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Selected Tube Turns Distributors in every principal city are ready to serve you from their complete stocks.

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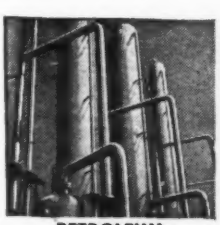
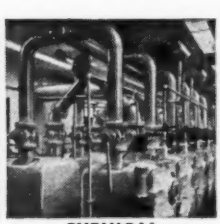
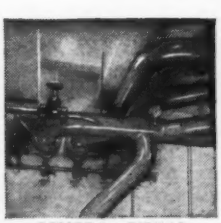
TUBE-TURN TRADE MARK **tt** *Welding Fittings and Flanges*



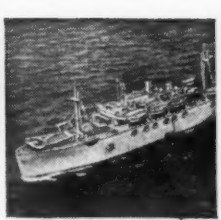
PETROLEUM



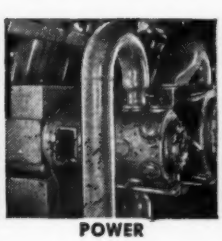
CHEMICAL



GENERAL PIPING



SHIPBUILDING



POWER

EQUIPMENT

POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
WASHINGTON NOTES • NEW DEVELOPMENTS • CONVENTIONS

U. S. Engineers to Aid Mexican Power Program

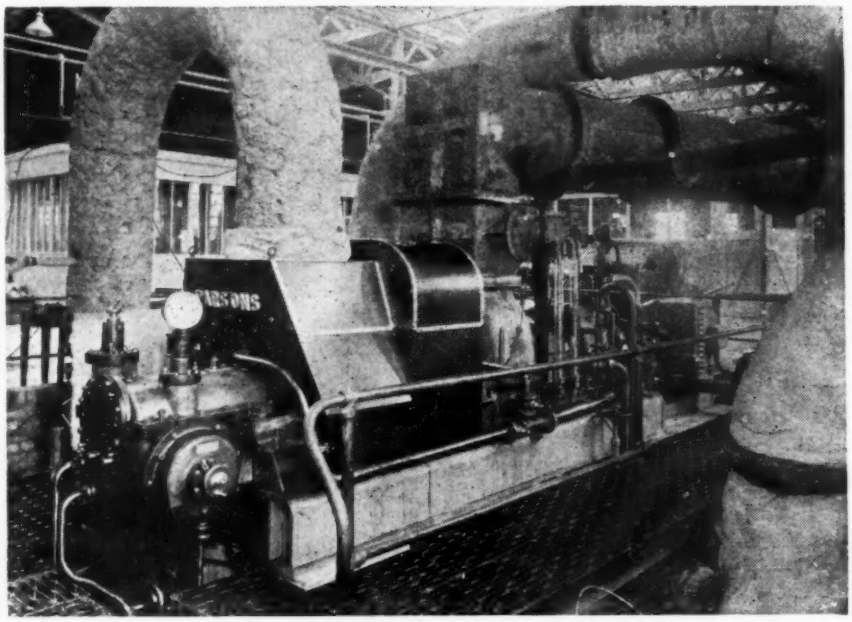
Editors' Note: The Mexican Government, in an effort to meet an expected critical power shortage resulting from heavy demand growth and prolonged drought, has enlisted the aid of U. S. engineers familiar with the methods used to solve similar wartime problems in this country. The following statement, prepared exclusively for McGraw-Hill World News, is the first official announcement of this action.

MEXICO, D. F. (McGraw-Hill World News): Announcing plans to meet an expected power shortage, Dr Oscar R Enriquez, General Director of Electricity, Ministry of National Economy, said: "Recognizing the value of informing the engineering profession through American technical magazines, among them POWER, we wish to publish the program by which the Mexican Government proposes to solve these problems, and also to express the thanks of the Mexican nation to all the engineers who are collaborating in this mobilization of electrical facilities."

Giving the details of the situation, Dr Enriquez went on to say, "World War II brought about everywhere a scarcity of products and commodities which brings about a serious lack of balance in the national economy.

"The Mexican Government is drawing blueprints and building works and plants to increase the power at the disposal of the nation. The present continental drought compels them to use to the utmost the producing capacity of its plants and installations. This refers not only to the central power-generating plants, but also to the array of installations which permit the current to reach the ultimate consumer of electrical energy. In order to use the available elements in the best way possible, a program of mobilization and reorganization of the Mexican plants and installations has been prepared and is now to be put into application. In this application, the Mexican Government is desirous of the cooperation of the most experienced

(*Continued on page* 190)



British Show Experimental Gas Turbine

London (McGraw-Hill World News): Experimental gas turbine, constructed by C A Parsons, Ltd, and Parsons Marine Steam Turbine Co, London, operates at 500 bhp and 6000 rpm. Incoming air drawn through a filter by an axial compressor reaches a regenerator at 50 psi. Waste heat is absorbed from turbine exhaust gas, and air continues to combustion chamber where it meets atomized fuel oil. High-temperature gas from resulting combustion expands through a turbine to drive compressor and dynamometer. A starting motor runs the unit up to 3000 rpm at which point fuel is admitted and a low-voltage starting plug furnishes ignition. An automatic clutch disengages the starting motor. The lubricating and fuel oil pumps are independently driven

COMING EVENTS

Nov 18-22—National Metal Exposition, Municipal Auditorium, Atlantic City, N. J. Chester L Wells, 7301 Euclid Ave, Cleveland 3, O. Following are holding annual meetings in Atlantic City at same time: American Society for Metals, Traymore Hotel (headquarters); Iron & Steel Div and Institute of Metals Div, American Institute of Mining & Metallurgical Engineers, at Claridge Hotel; American Welding Society, at Ambassador Hotel.

Dec 2-7—17th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York. Charles F Roth, exposition manager, Grand Central Palace, New York. Annual meeting of ASME will be held at this same time at the Hotel Pennsylvania, New York.

Jan 27-31—Electrical Engineering Exposition, 71st Regiment Armory, 34th Street and Park Ave, New York. E K Stevens, exposition manager, Grand Central Palace, New York. Winter convention of the AIEE will be held at this same time at the Engineering Societies Bldg, 29 W 39th St, New York.

Jan 27-31—International Heating and Ventilating Exposition, Lakeside Hall, Cleveland, O. Charles F Roth, exposition manager, Grand Central Palace, New York. Dates correspond with the 53rd annual meeting of the American Society of Heating and Ventilating Engineers in Cleveland.

Feb 24-28—American Society for Testing Materials, spring meeting, Benjamin Franklin Hotel, Philadelphia, Pa.

This is the way a Good Small Gate Valve should be built!

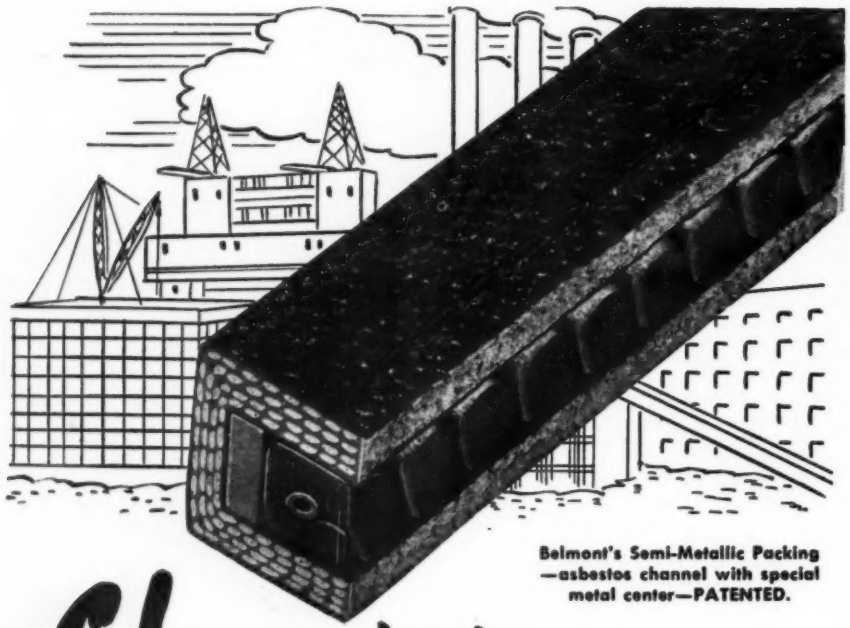
CHAPMAN LIST 960

Examine the List 960, and note its superior features. It has a bonnet fitted with a strong forged steel packing gland. This eliminates exposed threading on the valve yoke and provides dependable protection against rust and corrosion when the valves are used in exposed locations. Swivel bolts are used to hold the packing gland. There are no gaskets to blow as in valves with flanged bonnet connections. Stems, plugs and seat rings are of heat treated stainless steel, insuring greater efficiency in working qualities.

Made in sizes from ¼″ to 2″ — in carbon steel for pressures to 800 pounds; in alloy steel for pressures to 1000 pounds at 750° F. For higher pressures, specify List 990. Seats and plugs can be superhardened for extra severe services.

The Chapman Valve Mfg. Co.

INDIAN ORCHARD, MASSACHUSETTS



Belmont's Semi-Metallic Packing —asbestos channel with special metal center—PATENTED.

Closest to Friction*less Seal

Soft metal volutions which bulge toward the rod under gland pressure make Belmont's No. 865 Semi-Metallic Packing the ideal seal for high-pressure steam rods, valve stems and air compressor rods. It's a tight, metal-to-metal, practically friction-less seal.

The unique, spirally-wound metal is encased in a stitched asbestos channel. The packing is so flexible that it can be formed around small diameters.

Have your Belmont distributor furnish you with Belmont's 865 (ring form) or 866 (spiral form). For low pressure steam, hot and cold water rods and plungers and ammonia rods, specify Belmont 860 (ring) or 861 (spiral)—same as 865, with stitched rubber-and-duck channel on three sides.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

IN THE BLUE-AND-ORANGE BOX

THERE IS A BELMONT PACKING FOR EVERY SERVICE . . . Belmont distributors are located in every large industrial center, ready to give you prompt delivery from local stocks.

6 New Folders

Write us for new folders on Belmont Centrifugal and Rotary Pump Packings, Flax Packings, Hollow Center Packings, Oil and Gasoline Packings, Rod Packings, Sheet Packings.

THE BELMONT PACKING AND RUBBER CO.

Butler and Sepviva Streets

Philadelphia 37, Pa.

Engineer's Bookshelf

(*Continued from page* 146)

speed regulation, torsional vibrations and critical speeds. Then come chapters on intake, exhaust, heat-recovery, starting, cooling-water, lubricating-oil and fuel-oil systems and generators and electrical equipment. To aid in plant design, there are chapters on selection of engine sizes, power-plant buildings, and engine erection. Separate chapters deal with lubricating and fuel-oil characteristics and specifications. For the purchaser of engines, there are chapters on field testing and suggestions for preparation of bid invitations and detailed specifications.

Coverage of these various headings has been brought up-to-date and made authoritative under the supervision and checking of a committee of engineers representing the leading engine builders. This volume can be recommended unreservedly to any engineer using or planning to use diesel engines.

Canadian Hydro Power

WATER RESOURCES PAPER NO. 89. 351 *pp*, 6½x9½, *tables, stiff paper. Available on request. Dominion Water and Power Bureau, Dept of Mines and Resources, Ottawa, Ont., Canada.*

This report, another on Canada's water and power resources, presents results of hydrometric investigations in Ontario and Quebec by Dominion Water and Power Bureau, in cooperation with Hydro-Electric Power Commission of Ontario and Quebec Streams Commission, for the climatic years ending Sept, 1940 and 1941. Data are arranged according to the main basins included in the St. Lawrence and southern Hudson Bay drainage areas. Tables give, in second-feet daily discharge, the maximum, minimum and mean monthly discharge, and discharge per square mile; also runoff in inches for the drainage areas of each river in the basins that the report covers.

Industrial Carbon

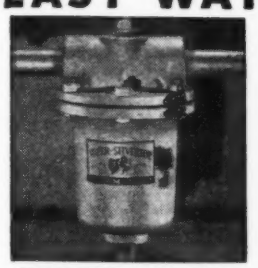
INDUSTRIAL CARBON, *2nd edition*, 1946. *By C L Mantell, consulting chemical engineer.* 472 *pp*, 6x9, 169 *illust*, 62 *tables, cloth*, $7.50. *D Van Nostrand Co*, 250 *4th Ave, New York, N. Y.*

Industrial carbon is here treated in its elemental, adsorptive and manufactured forms. Increases in application of carbon and industrial progress, since publication of the first edition 17 years

LET SUPER-SILVERTOP

pull the plug on loggy unit heaters

Do it the EASY WAY



STRAIGHT- IN-LINE

AS AN ELBOW

Water-logged unit heaters pour on the heat when you get the water out and keep it out. Super-Silvertops pull the plug and throw it away! How? By operating on the presence of water instead of its temperature. Presence of water, hot or cold, causes the Anderson Super-Silvertop to discharge. There is no loss of steam even on no-load or light-load operation.

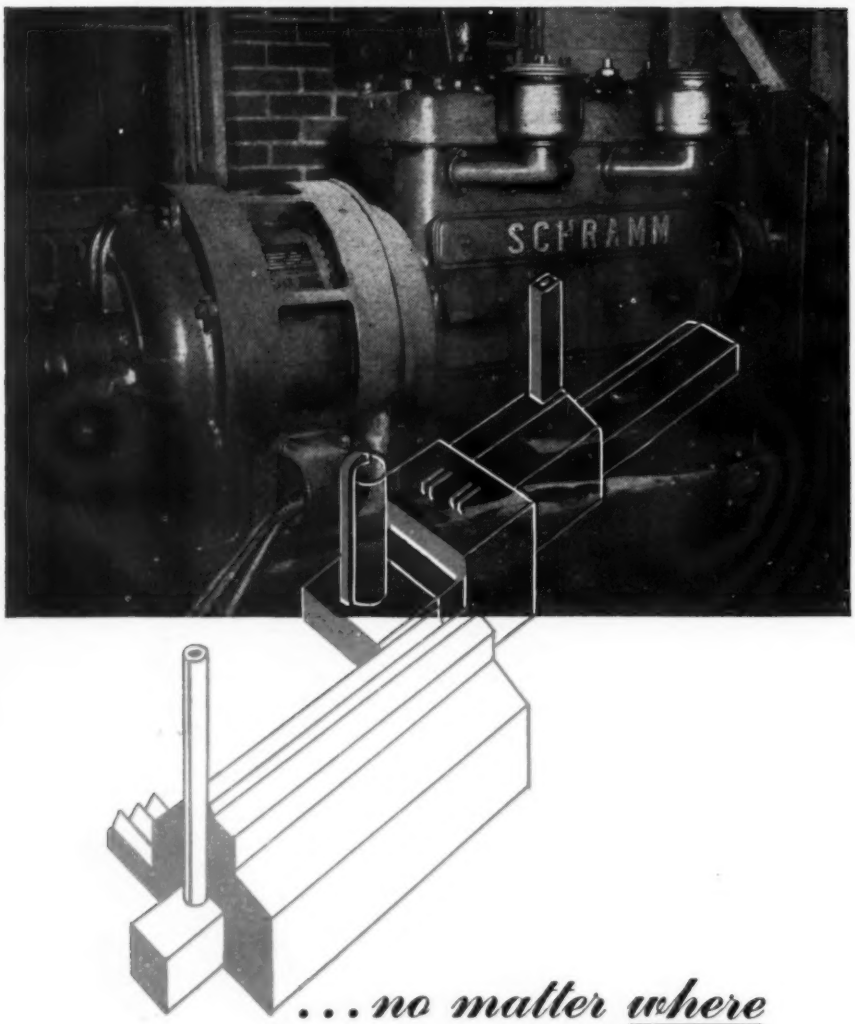
Super-Silvertop is an inverted bucket steam trap, the type of trap recommended by leading unit heater manufacturers. But, more than that, it is the inverted bucket trap that gives simplified piping without cored passages or split (pierced) gaskets. It's the trap with guided bucket, easy-to-remove valve and seat, increased capacity per dollar and a proved record of trouble-free operation.

A copy of the 40-page book, "How To Choose A Steam Trap", is yours for the asking—it gives facts and figures on trapping, as well as complete information on Super-Silvertop Steam Traps. Would you like to have a copy?

THE V. D. ANDERSON COMPANY
1934 WEST 96th STREET • CLEVELAND 2, OHIO

SUPER-SILVERTOP STEAM TRAP

VIBRATIONLESS



. . . no matter where

SCHRAMM AIR COMPRESSORS

are installed in your plant!

No vibration . . . but all the air you want! Schramm Air Compressors are easily installed, require a minimum of space, and are compact: yet NO VIBRATION!

Schramm Air Compressors are specified by industry today because they furnish all the air you want, whenever and wherever you want it. Each unit is tested before it leaves the factory, and goes to work as soon as it is installed.

Both stationary and portable units are available, in every size mounting and assembly. A new Booklet giving full construction details and advantages you get with Schramms is yours for the asking. Write us today for your copy.

SCHRAMM INC. THE COMPRESSOR PEOPLE WEST CHESTER PENNSYLVANIA

152 (795b)

ago, have made complete rewriting necessary. Elemental forms of carbon—the diamond, natural graphite, carbon black, acetylene black, lampblack and pigments with their applications—constitute the first major portion of the second edition. Wood carbonization and charcoal, subject of a chapter in the first edition, has been omitted. The adsorptive forms of carbon, which have increased enormously, are covered in the second major section.

The manufactured forms—artificial graphite, electrodes, brushes, arc-light carbons, specialties, resistors, electron-tube anodes, refractories, etc—constitute the third section. Fourth and concluding section gives analytical and test methods applied to all forms of carbon and their physical and chemical properties. Practical, comprehensive treatment makes this book useful to everyone interested in industrial carbon.

Temperature Resistance

TEMPERATURE-RESISTANCE CHARACTERISTICS OF ELECTRICAL INSULATION, 1946, *available on request.* 16 *pp*, 7½x10½, 15 *illust*, *paper*. *James G Biddle Co*, 1211 *Arch St, Philadelphia* 7, *Pa.*

Technical publication 21T4 by the company's engineering staff summarizes some of the published and unpublished information on temperature-resistance characteristics of electrical insulation. Nature of electrical resistance is discussed and, in particular, the wide variations in resistance of insulation materials due to temperature changes. How to make temperature corrections when testing insulation resistance is shown, thereby increasing the value of these tests as applied to electrical equipment.

AISE Meeting

(*Continued from page* 110)

Reliance Electric & Engineering Co. outlined the many applications to use dc adjustable-speed motor drives to advantage in the iron and steel industry. Incidentally, "spot conversion" means on-the-spot conversion from ac to dc at the location where power is applied.

Basic principle of spot-conversion drive is dc variable-voltage, commonly known as Ward-Leonard system. Such drives consist of four elements: (1) unit to convert from ac to dc (2) excitation source that can be controlled to provide variable-voltage dc (3) dc motor powered from the conversion unit (4) control for starting, stopping, control-

"ABSOLUTE Absence of Sludge ..."

since using Tycol turbine oils"

"Repair bills slashed 30% . . . Ten years without an oil change . . . Bearings show no signs of wear . . . Oil consumption cut in half . . ."

These results are typical of the unusual performance achieved with Tycol Turbine Oils. Refined by a special process, these modern lubricants stand up under the toughest service conditions . . . retain their original characteristics.

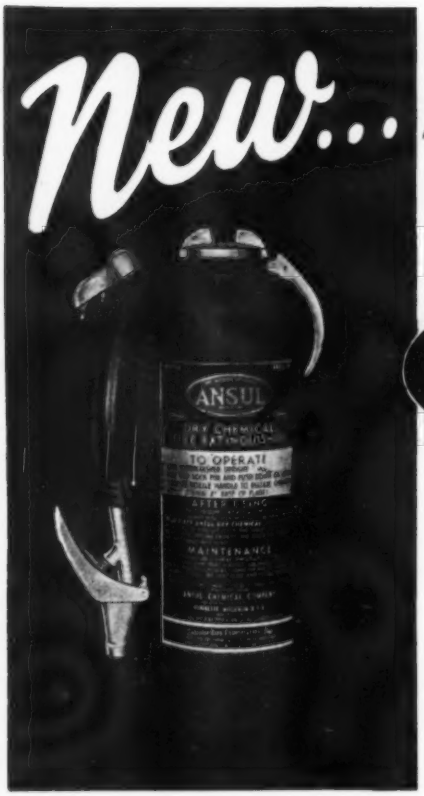
Call your nearest Tide Water Associated Office today for full information about the time- and money-saving advantages of Tycol Turbine Oils. Rust inhibited *Tycol RIO Turbine Oils* are also available for operations where corrosion is a factor.

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
Pittsburgh • Philadelphia

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE • NEW YORK 4, N. Y.

LUBRICATION—"ENGINEERED TO FIT THE JOB"



New... FASTER
FIRE STOPPING POWER
WITH
THE MASTER OF FLAME
ANSUL
REG. U.S. PAT. OFF.
FIRE EXTINGUISHING EQUIPMENT
du Gas
DRY CHEMICAL
FIRE EXTINGUISHERS

Greatly increased fire-killing capacity.

Simplified operation.

Expert performance by inexperienced operators.

Quick, easier on-the-spot recharge after use.

More fire stopping power pound for pound, dollar for dollar.

Greater heat-shielding protection for operator.

Increased fire-fighting capacity without increased weight.

Engineered to resist corrosion.

Install the NEW Ansul-Dugas Extinguishers at all hazard spots for greater protection against all fires involving flammable liquids, gases and electrical equipment.

Ready... in a Flash!

- Simply remove ringpin and push lever down.

- Open nozzle and direct chemical stream at base of flames.

53% More...
FIRE STOPPING POWER
with the NEW FASTER ACTING
ANSUL-DUGAS
FIRE EXTINGUISHERS

Write today for new catalog and authoritative data showing characteristics of all types of approved hand fire extinguishers.

Listed and Approved by Underwriters' Laboratories and Factory Mutual Laboratories.

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION • MARINETTE, WIS.

ling the speed of the dc driving motor.

A conventional conversion unit uses a squirrel-cage or synchronous motor to drive a standard dc generator. Excitation for generator and dc motor driving the load is supplied by a dc generator driven at constant speed by the main motor. Main generator's output voltage is varied by a field rheostat to adjust dc motor's speed.

Recently developed spot-conversion equipment uses a grid-controlled electronic rectifier. Rectifier output goes to the armature of the dc motor driving the machine. This motor is excited by a second electronic rectifier, which may or may not have its output voltage grid controlled. Such units can be built to give speed ranges up to 80 to 1. Spot-conversion units are built in sizes up to 200 hp completely assembled in a single housing to move from job to job as changing production needs require.

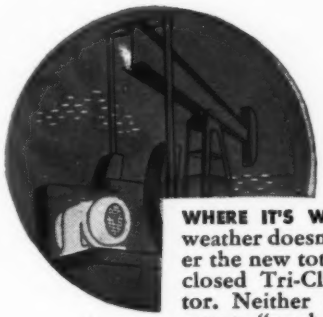
George A Kaufman, chief electrical engineer, Jones & Laughlin Steel Corp, gave distribution-system costs of ac compared to dc for variable-speed motor drives. He told of the many applications where his company has increased production and reduced costs by installing adjustable-speed dc motors supplied by spot-conversion units. These drives are so satisfactory that today his company's plants are studying almost all constant-potential motor drives for their replacement now or when repairs justify the changeover.

Crane motors are one of the few applications where the company feels sure constant potential motors are justified. Here the controlling reason is not the characteristics of the variable-voltage equipment, but rather that its weight would be prohibitive to carry on the crane structure.

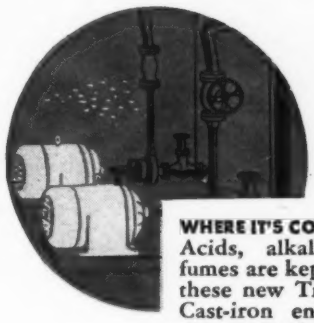
Lubricating Oils. Behavior of lubricants and their suitability for most applications are largely determined by their surface activities, according to J M Wilson, Shell Oil Co, in *Surface Activities of Lubricants.* Surface activities in general refer to lubricants' behavior at the interface where they contact other materials, which in service are commonly metal, water and air. Behavior at these interfaces varies widely, depending on lubricant source, method of its preparation, and kind and quantity of active additive materials present.

Other papers of interest to power engineers are *Analysis of Centralized Lubricating Systems From an Operating Standpoint,* by J P Gravenstreter, Carnegie-Illinois Steel Corp; *Rust Preventive Compounds,* by H Carpenter, Standard Oil Co of New Jersey; *Plugging Methods of Mill and Crane Motors,* by E J Posselt, Cutler-Hammer, Inc.

FOR TODAY'S TOUGHER JOBS, HERE'S A NEW TOUGHER MOTOR



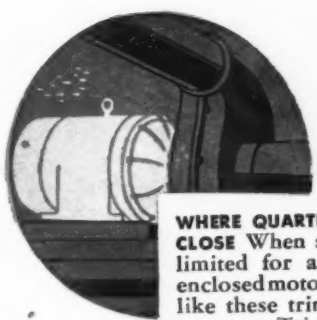
WHERE IT'S WET Wet weather doesn't bother the new totally-enclosed Tri-Clad motor. Neither do frequent "washdowns" in food plants.



WHERE IT'S CORROSIVE Acids, alkalis, and fumes are kept out of these new Tri-Clads. Cast-iron enclosures are corrosion-resistant, extra strong.

WHERE IT'S DIRTY Dirt and dust can't get into these Tri-Clads to shorten their life. Smooth surfaces are convenient to clean.

WHERE IRON DUST FLIES Harmful iron dust and metal filings can't get past the inner wall. Bearings are protected from dust.



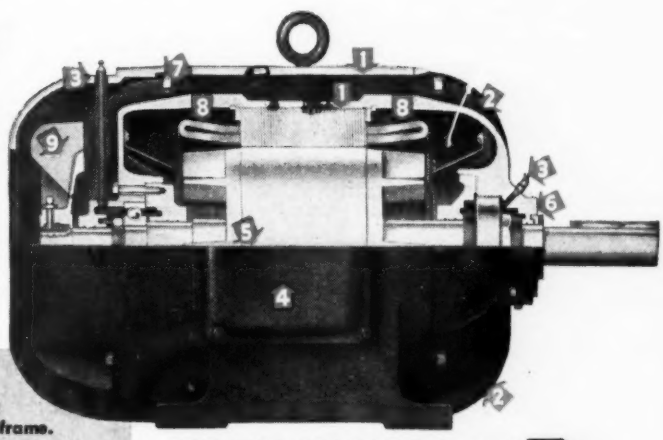
WHERE QUARTERS ARE CLOSE When space is limited for a totally enclosed motor, you'll like these trim, compact new Tri-Clads.

WHERE EXPLOSION HAZARDS EXIST The new Tri-Clad motors are available in explosion-proof constructions where needed.

THE G-E TRI/CLAD TOTALLY ENCLOSED MOTOR

(1 TO 1000 HP)

In 1940 you welcomed the Tri-Clad open motor with it's *extra protection features*. More Tri-Clads have since gone into service than any other integral-horsepower motor. Now G.E. is ready with a new line of tough, totally enclosed Tri-Clad motors for use in adverse atmospheres. *We believe they are industry's most dependable motors*. Their longer life and lower maintenance will make them a sound investment on almost every job. Apparatus Dept., General Electric Co., Schenectady 5, N. Y.



10-POINT PROTECTION

1. A cast-iron, double-wall frame completely encloses and protects the windings and punchings.
2. Corrosion-resistant cast-iron end shields are machined to provide a tight seal, and protect the motor from dust, dirt, and moisture. Primer and finish coat of Glyptal* varnish affords high rust-resistance.
3. A pressure-relief greasing system, which can be packed with long-life lubricant, protects the bearings.
4. The cast-iron conduit box is diagonally split for easy wiring. Boxes are independently explosion-proof on Class I motors.
5. Nonshrinking compound around motor leads protects motor interiors from dust and moisture at the point where leads pass through the frame.
6. Rotating labyrinth seal further protects motor interior from damage by foreign matter.
7. Large air passages provide adequate protection from overheating. They're easy to keep clean and open, too.
8. Modern, "ageless" insulation treatment includes windings of *Formex magnet wire.
9. The powerful external fan is removable to simplify maintenance; nonsparking type in explosion-proof motors.
10. Individual dynamic balance of rotors and external fans protects against vibration hazards, even under severe operating conditions.

*Trade-mark Reg. U. S. Pat. Off.

FOR THE COMPLETE STORY

Apparatus Department, Section G750-278C
General Electric Company
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☐ Please send me GEA-4400, which describes the new Tri-Clad totally enclosed motors.

☐ Please send me GEA-4131, "Motors and Control for Hazardous Locations."

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● Davis Stop-and-Check Valves have long been "Standard for Safety" in boiler plants throughout the nation.

NO. 101 — Designed particularly for finest high pressure, heavy duty steam plants. Features an external oil dash pot and counter-weighted lever which can be moved by hand at any time to test the valve and also provides visible action. Inside, it is as clean and simple as a streamlined globe valve.

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BOTH TYPES are available in a complete range of sizes. Globe, angle, corner or elbow body patterns. Semi-steel, carbon steel, or alloy steel bodies, with suitable trim for any pressure and temperature. For prompt service, send an outline of your requirements to the

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DAVIS VALVES — DAVIS REGULATOR COMPANY

High-Temperature Piping

(*Continued from page 71*)

Austenitic 18% chromium, 8% nickel steel with a low carbon content has found considerable use for high-temperature bolting under conditions that are corrosive.

Graphitization a Problem. Within the past three years the susceptibility of piping materials to graphitization has come to be recognized as a major problem. Graphitization means a change in form of the carbon present in steel from the dissolved state to the free or graphitic state caused by prolonged exposure to high temperature. While some graphite may appear anywhere throughout a pipe or casting susceptible to this trouble, it is more apt to occur at the low-temperature side of the zone affected by the heat of welding. Here the maximum temperature reached was just below the eutectoid transformation of the conventional iron-carbon diagram.

Susceptibility of welded joints to graphitization was not encountered until carbon-steel pipe was operated above 800 F and carbon-moly above 900 F. Extensive field explorations with weld probers were undertaken after failure of a welded joint at Springdale station of West Penn Power Co early in 1943. Examination disclosed that graphitization had caused this failure in a 12-in. Schedule 160 carbon-moly pipe, which had been in service several years at temperatures of 935 F and higher.

Fortunately, only moderate amounts or traces of graphite have been found in most other joints where graphite has been discovered, but the tendency for graphitization to progress to more serious stages has to be carefully watched. If graphitization progresses too far, it is doubly deleterious in that (1) a noticeable reduction in dissolved carbon tends to lower the impact strength and ductility of the steel, and (2) segregation of graphite at the outer edges of the heat-affected zones in welded joints may tend to form cleavage planes where brittle failure can take place.

Power companies, steel mills, piping fabricators and valve manufacturers have worked together in laboratory and field to find causes of graphitization and to learn how to prevent it. Engineering societies have provided forums for presenting papers and have published the results of investigation. Through the mutual efforts of these agencies, discoveries of graphite in field sampling of welded joints were further

Wire ahead...

for business ahead

UNFORTUNATELY, you can't actually see the production that isn't there. But, if your wiring is obsolete, overtaxed and over extended, you are losing from 25 to 50 per cent in the efficiency of machines and workers.

So it may well be that many a unit you pay overhead and wages for . . . *isn't there!*

To find out whether your wiring is efficient, up-to-date, *adequate*, consult with your plant power engineer, your consulting engineer, electrical contractor or power salesman. A wiring survey now may save costly shut-downs and expensive alterations later.

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DARTS are Quickly Demountable

TWO BRONZE SEATS GROUND TO A TRUE BALL JOINT PERMIT EASY UNCOUPLING

Whenever you wish to move a Dart Union to a new location, you'll find no trouble in uncoupling it. Because of its two bronze seats which have been ground to form a true ball joint, it closes to a drop-tight connection without excessive wrenching. Thus, undamaged, it will open easily whenever needed elsewhere.

Body and nut are of high-test air-refined malleable iron — are practically unbreakable.

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DART UNIONS

analyzed by accelerated tests in which specimens of these and other steels were heated in laboratory furnaces.

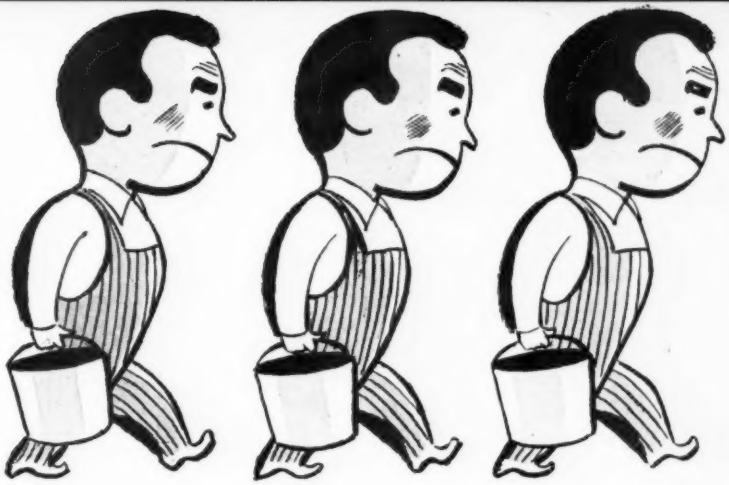
Typical photomicrographs illustrating the several degrees of graphitization in welded joints of carbon-moly pipe are shown in Fig. 5. Investigations have disclosed that tendency to graphitization is influenced by several factors, among which are: (1) chemical composition of the steel (2) melting practice followed in manufacture of the steel, and whether its McQuaid-Ehn grain structure is "normal" or "abnormal" (3) extent of cold working during fabrication without subsequent heat treatment (4) bad effect of welding heat and beneficial effect of correct stress-relieving temperature on pipe metal adjacent to the weld (5) operating temperature (6) intensity and direction of stress in the metal in service, and (7) length of exposure to temperature in service.

Generally speaking, carbon steel is relatively more susceptible to graphitization than carbon-moly; that is, the former will graphitize in a shorter time or at a lower temperature. Also, "abnormal" carbon steel or carbon-moly steel deoxidized with a preponderance of aluminum is more susceptible than low-aluminum "normal" steel killed with a preponderance of silicon. Addition of ½ to 1% of chromium to a molybdenum steel promises to give immunity to graphitization at operating temperatures of 900 to 1000 F.

The general problem of graphitization and the influence of different factors thereon point to the need for exercising greater care, in specifying and fabricating pipe for high temperature service, than had been suspected up to three years ago. Those responsible for satisfactory performance of high-temperature piping installations can well take note of the possibilities for getting into trouble and be cautious in selection of materials and workmanship. Otherwise, periodic sampling of welded joints may be necessary to keep track of any progressive tendency to form graphite. In the end, this may culminate in the need for replacing the whole piping system at considerable expense and with attendant loss in the use of equipment, which may be even more serious.

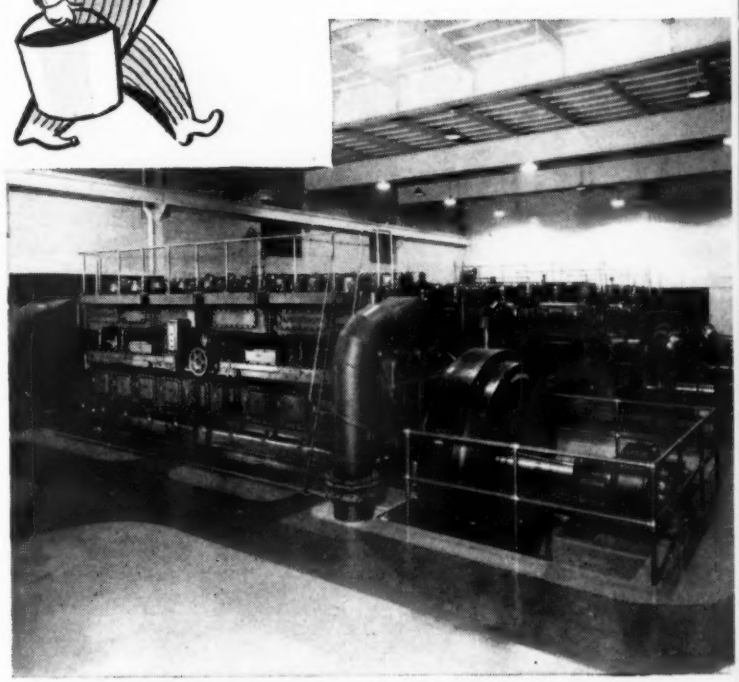
Chromium Carbides. Chromium-bearing steels are susceptible to another form of "carbon" trouble. This develops with time and temperature in heat-affected zones adjacent to welded joints if the steel is not adequately stabilized through the addition of considerable amounts of columbium or titanium or equivalent metals. Chromium in solution in steel, if given sufficient time

From 3 buckets of port carbon a week to just one



BEFORE this Illinois Municipal power plant operated on Nonpareil HD Diesel Oil, the three Diesels—one 850 H.P. and two 1,050 H.P. engines—were cleaned of port carbon weekly. Three 12-quart buckets of carbon were removed at each cleaning. When the 2,000 H.P. engine in the foreground was installed Nonpareil HD Diesel Oil was used. One of the immediately noticeable results was the comparative freedom from port carbon deposits on this new Diesel. Within a year the three older engines were put on Nonpareil HD. Then there was no doubt. Port carbon dropped to one-third—less than one bucket of carbon a week for all three engines.

Minimizing of port carbon is just one of Nonpareil HD's maintenance saving advantages which operators *have proved for themselves* in hundreds of similar installations. What is your Diesel lubricating problem? There's a Standard Oil Lubrication Engineer ready to help you solve it if your plant is located in the Midwest. Just write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

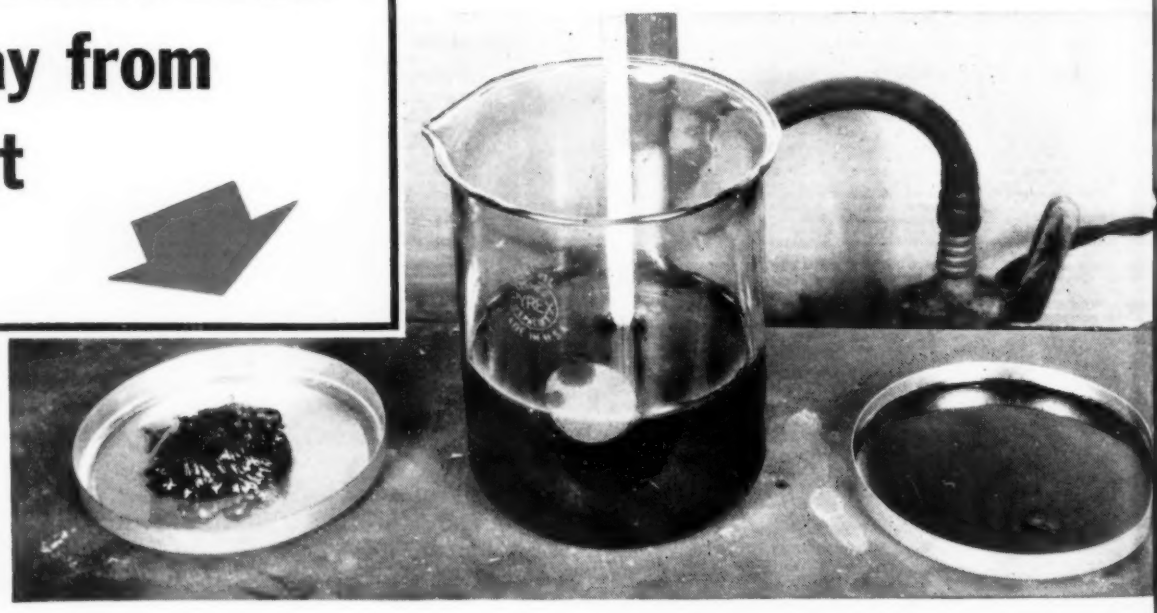


NONPAREIL HD DIESEL OIL

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

A gear lubricant that won't run away from heat

(Above) Two samples of grease, Calumet Viscous Lubricant on left and a residuum type gear shield, right. These samples are placed on a hot plate (below) and heated to 320°F. as determined by the thermometer in the beaker of oil. Within 60 seconds the old type gear shield has melted and spread over the pan. There is little or no change in structure of Calumet Viscous Lubricant even at this high temperature.



THE SIMPLE TEST described here shows why Calumet Viscous Lubricants reduce throwoff, cut lubricant consumption and protect open gears for long periods of time even though subjected to elevated temperatures.

Calumet Viscous Lubricants have these qualities because they are not the old type gear shields but are true greases made from selected soaps and oils of proper viscosities. They do not require heating before application, and all but the heaviest grades can be sprayed. Both features offer a further saving in time and grease.

A Standard Oil Lubrication Engineer will help you select the grade you need for low cost open gear lubrication.

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STANDARD SERVICE

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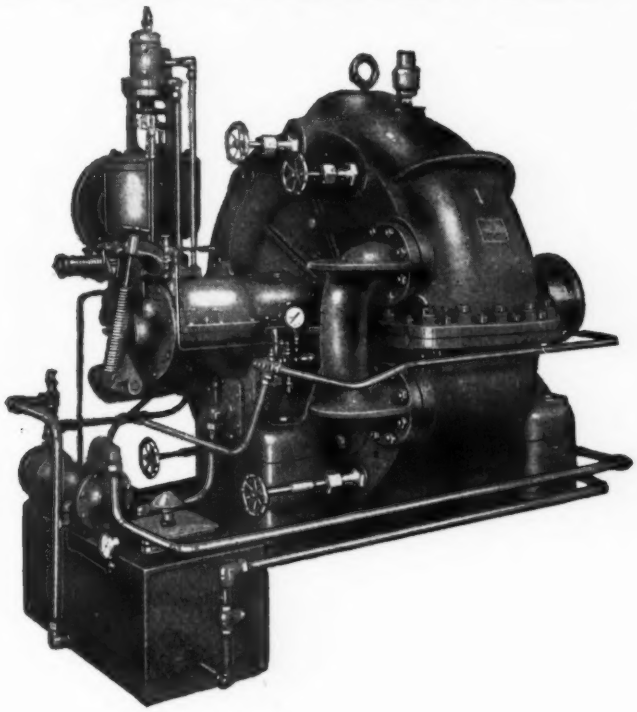

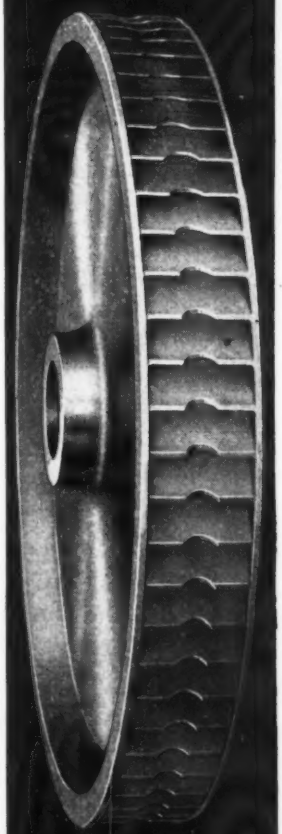

THE WHEEL OF THIS 165 lb. BACK PRESSURE TURBINE IS DOUBLE RIM PROTECTED

The 925 H. P. Back Pressure Turbine shown above employs a Terry Solid Wheel Rotor as shown at the left.

The buckets are protected by rims at the sides of the wheel. These rims would take without damage any rubbing that might occur if the clearance became reduced.

With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearings are not required to obtain safe and dependable operation.

The Terry Wheel Turbine is fully described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1165

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

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IT'S RUST INHIBITING

Because B-H No. 1 Cement contains a rust inhibitor which prevents corrosion of metal surfaces, it is excellent for use on flanges, valves, and other fittings. Even if used on cold, slow drying surfaces it forms a firm, rust-free bond.

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Just mix B-H No. 1 Cement to a trowelable consistency and apply. It sticks, even to smooth surfaces—makes covering of under surfaces and pipes easy, even for unskilled workmen.

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The exceptional efficiency of B-H No. 1 Insulating Cement is due to the high temperature resistant *black* rockwool from which it is made. The dead air cells in the nodules of rockwool provide maximum insulating efficiency and lightness in weight. B-H No. 1 Insulating Cement dries without cracking—withstands temperatures of 1800°F.—and is reclaimable if temperatures have not exceeded 1200°F.

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Packed in convenient sized multiwall paper bags containing 50 lbs. Ready for instant use. There is no loss or breakage as with molded types of insulation.

The coupon below will bring you full information and a practical sample of B-H No. 1 Insulating Cement.

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☐ No. 100 Pipe Covering—effective up to 1200°F. (for long runs overhead, underground, Diesel exhausts).

☐ Mono-Block—the one-block insulation for all temperatures up to 1700°F.

☐ Black Rockwool Blankets (felted between various types of metal fabrics).

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at the right temperature, has an affinity for carbon, which it tends to pick up from the iron-carbide constituent of the steel, forming chromium carbide.

Since the carbon, which teams up with the chromium content to form chromium carbide, must come from the iron-carbide constituent of the steel itself, it follows that low-carbon steels are less susceptible to this trouble than are medium to high-carbon steels. Hence the more chromium in the steel, the less the permissible carbon content. For steels containing much chromium, a range of 0.08 to 0.15% carbon is maximum.

Formation of chromium carbide in high-chromium steel is objectionable on two counts: (1) It tends to reduce the amount of chromium in solution in the steel in which it was placed primarily for its corrosion-resisting properties. (2) Particles formed tend to migrate to the grain boundaries where they cause intergranular weakness that embrittles the steel.

Austenitic steels are more prone to develop carbide embrittlement than are ferritic steels. Competent metallurgists are aware of these tendencies and select chromium-bearing steels so stabilized as to minimize or inhibit a transformation into chromium carbide adjacent to welded joints. With air-hardening steels containing 4 to 6% chromium, the presence of a stabilizer also facilitates welding in that it reduces the air-hardening tendency.

Suit Work to Conditions. Executing in the shop operations that can be done to better advantage there than on the job not only results in safer piping installations but also offers opportunities for reducing costs. For best results and least cost, a job should be planned from the beginning, with work assigned in the layout stage to the location where it can be done to advantage. Experienced fabricators and erectors can offer valuable advice to their customers on this score if consulted in time. Because few jobs are of sufficient size to warrant installing, at the site, facilities equivalent to those in the well-organized shops of pipe-fabricating companies, such shops will continue to do much of the work on high-pressure high-temperature piping.

H L Watson, De Laval Steam Turbine Co, announced completion of plans for one of the largest Government-sponsored aircraft gas-turbine experimental projects in the country. Project involves, it is understood, new concepts of compressor and gas-turbine design closely associated with Rudolph Birmann, consulting engineer, formerly with the De Laval organization.

Headquarters for the

MOST COMPLETE LINE
of DROP FORGED STEEL VALVES, FITTINGS & FLANGES

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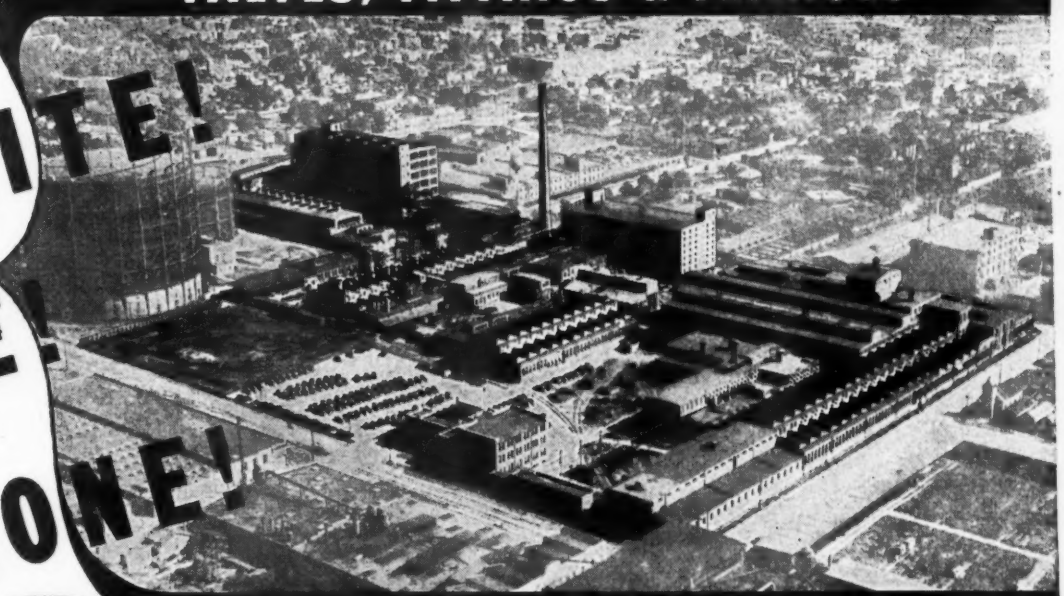

Air View of Henry Vogt Machine Co. Plant, Louisville, Ky.

VOGT provides one convenient, economical source of supply with the most comprehensive line of drop forged steel piping materials anywhere available to industry. Here will be found everything needed for the safe and efficient control of oil, steam, water, air, gas, and ammonia at high or low pressures and temperatures.

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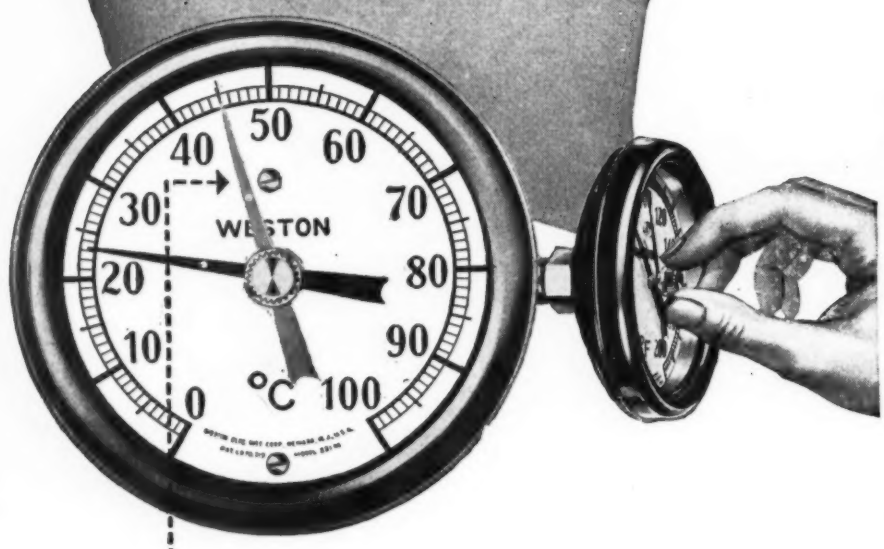
NEW all-metal WESTON MAXIMUM-MINIMUM Thermometer



RED INDEX shows the highest or lowest temperature reached!

Simply swing the red index to the low side of the temperature pointer, and the index will move to the *lowest temperature reached*, and *remain there* until manually reset. For *highest temperature* record, simply swing the red index around to the high side of the pointer.

The index movement in no way impairs the guaranteed high accuracy of the WESTON Thermometer.

Thus the WESTON Maximum-Minimum Thermometer provides, at only slightly above ordinary thermometer prices, a means of obtaining high or low temperature records on equipment or processes where these extreme temperatures are critical. Ideal for transformers, sterilizers, ovens, chemical equipment, food processing, etc. For complete information, consult your nearest WESTON representative.

WESTON ELECTRICAL INSTRUMENT CORPORATION
617 Frelinghuysen Avenue, Newark 5, New Jersey

Softener Operation

(*Continued from page* 85)

These figures were obtained at relatively low rates of raw-water flow, averaging about 8000 gph. If the assumption is correct that maintenance costs vary with hours of service instead of gallons of water softened, difference in chemical costs becomes more noticeable as more water is treated. A point may then be reached where the lower-priced chemicals may be more economical regardless of maintenance. This can be foretold by comparing costs by the formula:

$$\text{Chemical cost per M gal} + \frac{\text{maintenance cost per hr}}{\text{flow (M gal per hr)}}$$

Curves derived from this formula using figures at this plant are shown in Fig. 4. Here, lime is as economical as caustic soda when softening 200,000 gph, if the benefits of more effective proportioning are ignored.

Using caustic soda with this water, which has an average of 24 ppm carbonate hardness and 99 ppm noncarbonate hardness, reduced the demand for soda-ash feed to 54.4% of that required for lime. The $0.0069 increase in chemical cost per 1000 gal is an economical way to obtain the $0.106 per 1000-gal reduction in total cost and the uninterrupted equipment service that makes good control of the softening operation possible.

Reader's Problems

(*Continued from page* 121)

ically stable and resistant to oxidation. (2) Do not overfeed oil to cylinders. A rule of thumb for determining rates of feed is to allow one 3/16 in. drop of oil for every 4 in. of cylinder diameter. (3) If there is dust or foreign matter in proximity of air-compressor intake, install a good type of air filter. It is good practice always to install a filter. (4) Drain air receiver daily.

Scotia, N. Y. R G MELROSE

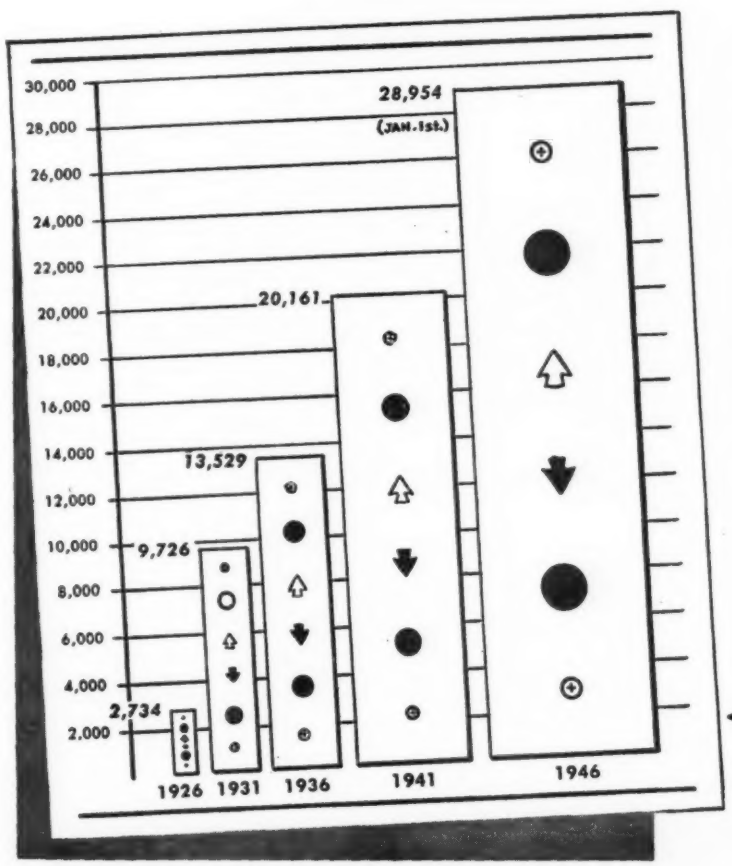
Maintain Close Inspection

EXPLOSIONS USUALLY RESULT from combustible vapor in receiver or pipe-lines. This trouble is avoided by keeping carbon out of compressor valves, and oil pockets out of the pipeline. This means supplying least amount of oil that effectively lubricates compressor

Milestones in Service

Otis Maintenance for Otis Elevators

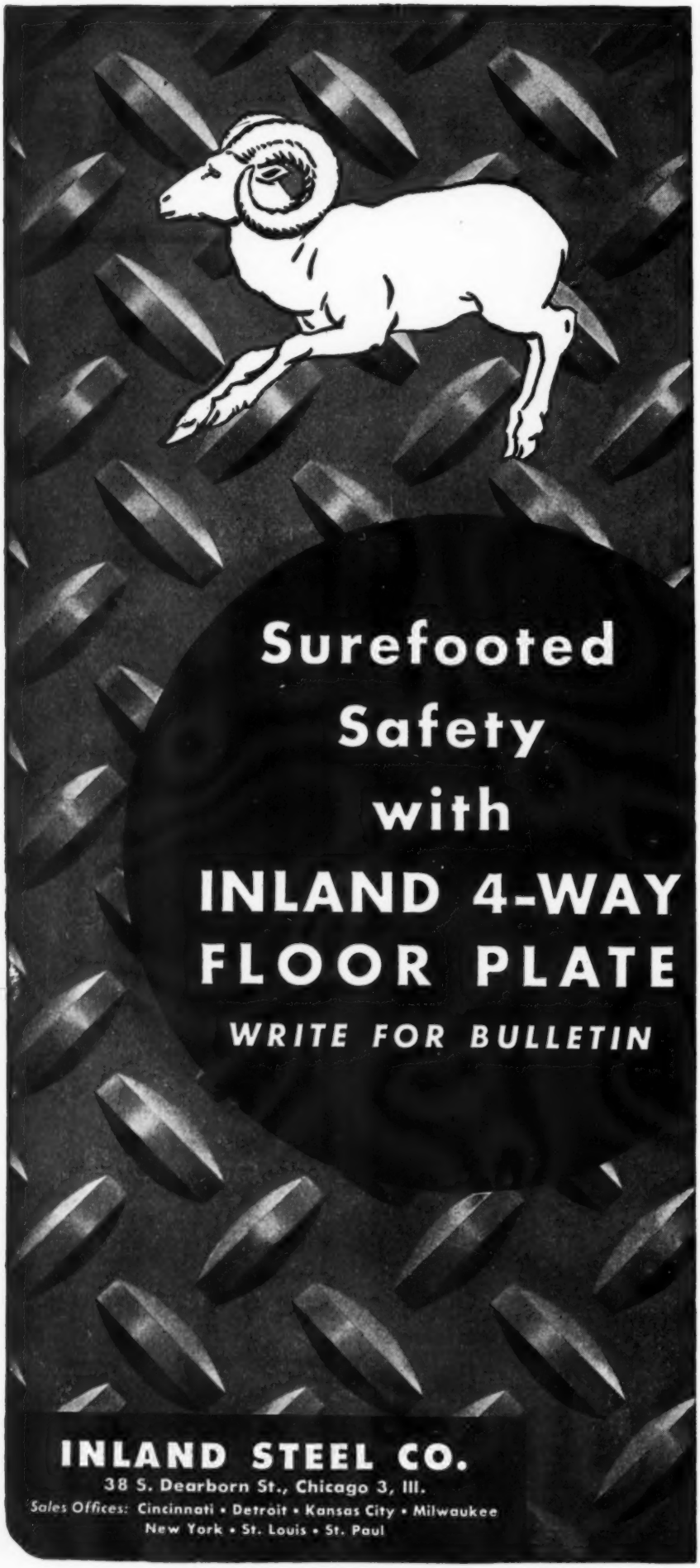
There are 245 Otis offices* but only one Otis Maintenance Service. • This service is a home town enterprise in operation, so that it may be adapted to the area it serves. It is a national enterprise in research, engineering and manufacturing so that each Otis elevator owner may have the best that concentration and quantity production can provide. • Perhaps the strongest indication of the merit of this service is its growth and development. For more than a quarter of a century, in good times and bad. Otis Maintenance has proved the wisdom of one policy, one system and national service for Otis Elevator owners. • Otis Maintenance provides complete care of Otis elevator equipment by the manufacturer. It is furnished at a flat monthly rate. Complete details are available through local Otis Elevator Company offices.



←Number of Elevators under Otis Maintenance. The steady increase in the number of elevators maintained for owners by Otis offers convincing proof of the economy and efficiency of *maintenance by the manufacturer.*

Otis offices in 245 cities have but one interest . . . to provide the best and safest elevator and escalator transportation possible.

Otis
ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES



(about 4 to 6 drops per min for a 1000 cfm compressor). Use heavy-medium viscosity oil with high flash-point, fed through lubricators.

Other suggestions are: (1) Use fusible plug set for 400 F near the discharge valves. (2) Install a thermometer in discharge pipe close to compressor. If temperature rises above 350 F, shut down machine. (3) Install aftercooler as close as possible to compressor. (4) Keep intake-air filters clean. After every 150 to 200 hr of operation, feed in a few gallons of solution of castile soap and water. (5) Maintain tight air baffles and water partitions in intercoolers. Inspect air valves regularly, and replace or regrind valves whenever needed. (6) Clean all air passages periodically between cylinders and intercoolers, also piston heads and rings. (7) Don't operate unit unloaded for long periods.

Dolbeau, Que. ERNEST HOPKINS

Avoid Leakage Through The Exhaust Valves

SHC ASKS WHAT CAUSES explosions and fires in air compressors and compressed-air systems, and how to eliminate them as far as possible.

Work of compressing air generates heat, which must be dissipated through cylinder cooling, inter-stage coolers and aftercoolers. Assume a 2-stage machine discharging from low-pressure cylinder into an intercooler and directly from high-pressure cylinder to receiver and system. Also assume 70-F entering-air temperature and cooling to 100 F in the intercooler. With this as a basis substitute in the equation of polytropic compression:

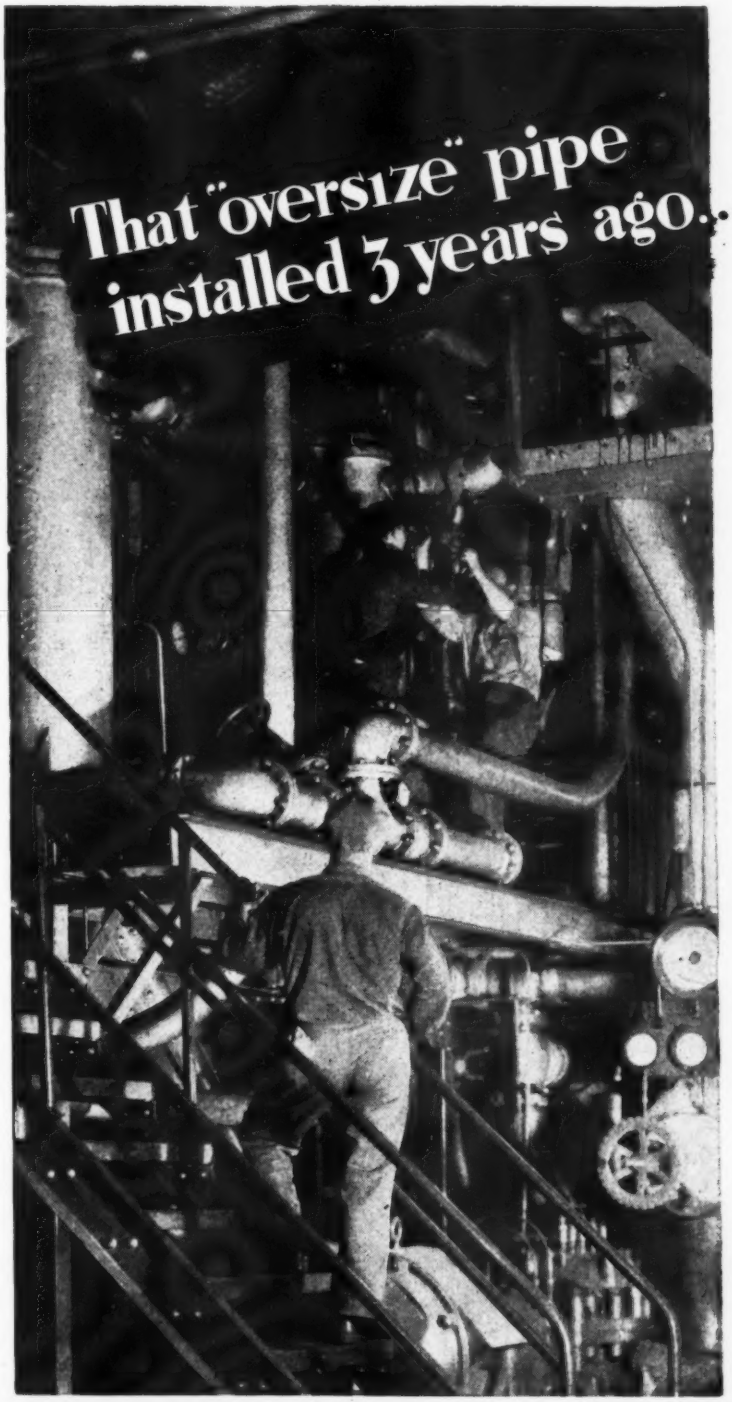
$$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{K-1}{K}}$$

Discharge temperature is 191 F and second-stage discharge temperature is 338 F. If there is enough leakage through discharge valves to produce a temperature equal to the mean between entering and leaving temperatures in the second stage, final temperature becomes 488.5 F. If same condition exists in first-stage cylinder, and there is a dirty intercooler or one inadequately supplied with cooling water, discharge temperature from intercooler is 337 F, and final temperature 429.2 F. Second-stage temperature, as in first stage, is 596 F.

From above deductions it would be possible to produce a temperature in final stage that would cause self-ignition of lubricating oil. This would probably have disastrous results.

New Orleans, La. W R KILBOURN

INSTALL STEEL PIPING ADEQUATE FOR TOMORROW'S NEEDS



That "oversize" pipe installed 3 years ago...takes care of the new extension

THE owner of an eastern food plant is congratulating himself on what he had always thought was an extravagant, though necessary investment. A few years ago, when he installed new processing equipment, the only pipe he could secure quickly was what he thought was "oversize." But he put it in.

Now greater demand for his product is leading him to increase his plant capacity. One thing he isn't worrying about is his piping system. That "oversize" pipe of 3 years ago is adequate to handle the extension. Today he *knows* it was an excellent investment.

Too many owners--and contractors, too--are inclined to rely on minimum pipe sizes--not anticipating that what's barely adequate now may soon be completely inadequate. Remember--it's long run economy to install steel pipe adequate to do a job today AND TOMORROW.

Distributors in all industrial markets handle Youngstown pipe in a wide range of sizes.

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GENERAL OFFICES - YOUNGSTOWN 1, OHIO

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Pipe and Tubular Products - Sheets - Plates - Electrolytic Tin Plate - Coke Tin Plate.

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When critical materials, tools, dies, parts or machinery are needed fast to prevent costly production delays in your business — GET IT BY AIR EXPRESS and let this fastest delivery service pay its way many times over.

Rates are drastically down from pre-war days — a new economy that makes this service a greater money-making tool than ever, for thousands of firms throughout the nation.

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349	1.02	1.18	2.39	3.68	9.21c
549	1.07	1.42	3.84	6.14	15.35c
1049	1.17	1.98	7.68	12.28	30.70c
2349	1.45	3.53	17.65	28.24	70.61c
Over 2350	1.47	3.68	18.42	29.47	73.68c
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Representing the AIRLINES of the United States

Avoid Explosive Vapors

IF SHC PLACES FILTERS in air intakes of his compressors, to prevent combustible dust entering compressors he will go a long way in reducing possible explosions. This will also keep pistons, cylinders and air valves cleaner, thus reducing wear and maintenance. Combustible gases and vapors should not be allowed near the air intakes. If compressor is opened for cleaning valves, rings, etc, or for repairs, allow no one to use kerosene or kerosene-soaked rags or other combustible cleaners because, if compressor is quickly assembled and put back in service, an explosion may result.

Avoid over-lubrication because if compressor becomes over-heated oil vapors are likely to be created which may promote an explosion.

Keep unloader or pressure regulator and pressure gages in good condition to guard against over-pressure explosions. Air-discharge system should be kept air tight, piston rings kept clean and working free in the grooves.

Montreal, Que. ARTHUR BELTON

Good Maintenance Prevents Fires

WE HAVE HAD TWO FIRES and an aftercooler explosion in our compressed-air system. We operate four synchronous motor-driven duplex units and one compound steam-driven duplex unit. Air is compressed to 42 lb per sq in. Although the steam-driven unit has never given trouble in its valves, motor units require a rigid valve-maintenance program to avoid trouble.

Both fires and aftercooler explosion were caused by broken discharge valves, coupled with insufficient amount of cooling water in the after-cooler. When a discharge valve breaks, cylinder begins to heat up immediately. A spark in a cylinder full of hot-oil vapor can cause a lot of trouble. Once a fire starts all compressors must be stopped to shut off air flow; otherwise fire spreads to all parts of the system. Pipe section containing the fire should be isolated, the pressure relieved, and the line filled with CO_2.

So. Vineland, N. J. T DEROSA

Thermometer Checks Air

AIR-COMPRESSOR EXPLOSIONS are caused by oil and carbon deposits raised to a burning temperature. *SHC* should use oil suitable for air-compressors, and as little as possible. Regular inspection and removal of carbon deposits serve as a check on lubrication, and reduce possibility of explosions.

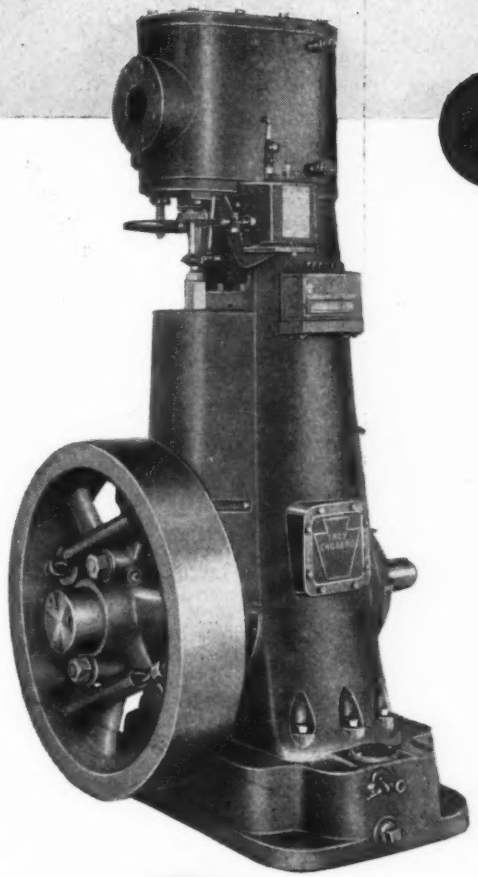
3 LOW COST POWER FEATURES

TROY-ENGBERG
STEAM ENGINE

SIMPLE DESIGN

STURDY CONSTRUCTION

CONSERVATIVE SPEED



Thousands of Troy-Engberg Steam Engines have been operating for 10 to 20 years, even longer, without need of major repairs. This contributes to the exceptionally low power cost produced by these engines throughout industry.

Why not investigate the advantages of using the Troy-Engberg Steam Engine in your plant? If you use steam for processing or heating and if you are operating such equipment as compressors, blowers, pumps, stokers, generators, etc... you have the setting for a profitable investment in low cost power.

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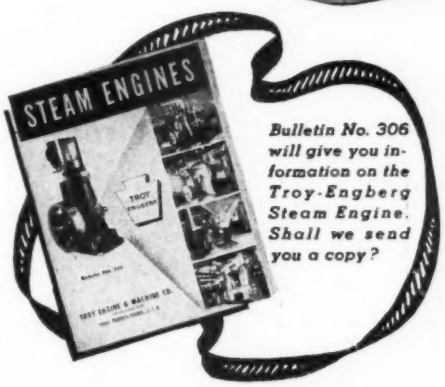

Bulletin No. 306 will give you information on the Troy-Engberg Steam Engine. Shall we send you a copy?

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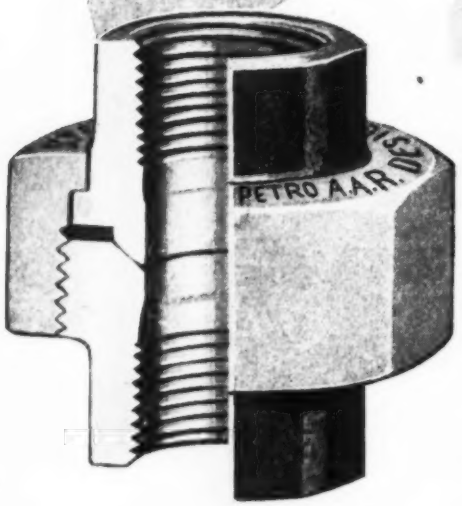
ENDURANCE

in FORGED STEEL UNIONS



SIZES ⅛" TO 3"

Petro

AMERICA'S MOST UNIVERSALLY USED UNION

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S.W.P.-2000 lbs. C.W.P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

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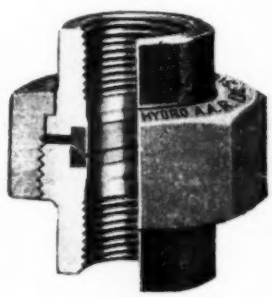
Pressures from a vacuum to 3000 lbs. Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is Used.

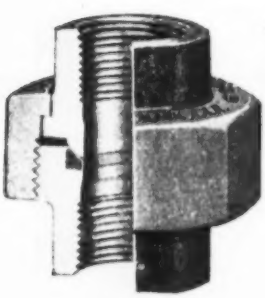
Hydro

THE ONLY FORGED STEEL UNION WITH TWO BRONZE SEATS

Made to A. A. R. design. 600 lbs. S.W.P.-2000 lbs. C.W.P. HYDRO unions have extra heavy ends and nut, with the nut threads permanently lubricated. The bronze seats are completely fused to the steel and are then machined and cold rolled.



SIZES ¼" TO 3"



SIZES ¼" TO 3"

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ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS

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Check the decrease in heat-transfer efficiency of cooling surfaces caused by scale or improper ventilation. Low points where oil accumulates serve as reservoirs of fuel for an explosion. A thermometer is helpful in checking dangerous temperatures in discharge air. A fusible plug in discharge line close to the compressor acts as a safeguard. Air cooler should be as near compressor as possible because trouble usually starts in the line that connects these two.

Leaking discharge valves allow the air, heated by compression, to return to cylinder, where it causes temperature increase. If leakage is sufficient this cycle could continue until a temperature is reached that ignites combustible oil.

Bronx, N. Y. H H DEMLING

Check Operating Pressure

LEAKY RINGS MAY readily cause an explosion in compressed-air system with duplex compressors. Air under compression is always hot. Leaky rings allow part of air under compression to pass, thereby entering cylinder of incoming air. Recompressed air is heated to higher temperature. Should this cycle continue unchecked an oil-vapor explosion would result or compressor would become so hot a major breakdown would occur.

Gage lines and valves must be open at all times. If machine is watercooled be sure cooling water is flowing, and automatic water controls working. Never run a machine at higher speed than that specified by manufacturer; keep constant check on check valve between compressor and air tank.

Quincy, Florida D J PARMER

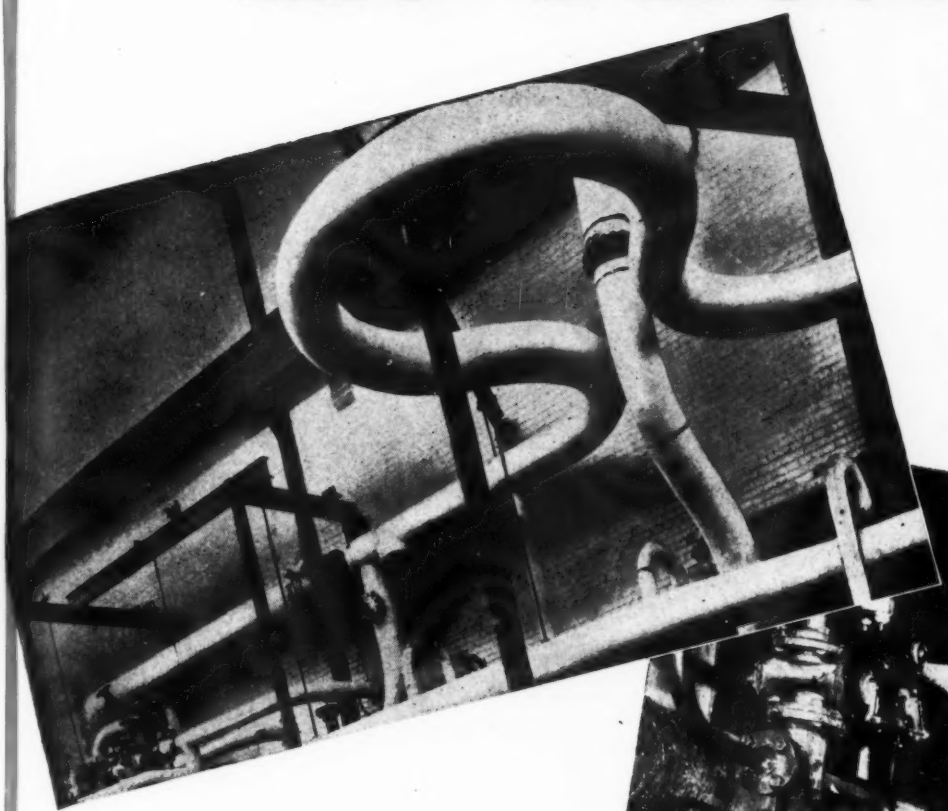
Leaky Valves Cause Fires

LEAKY DISCHARGE VALVES can cause air-compressor explosions. Air, compressed and discharged from the compressing cylinder, carries off heat of compression. If a valve lets hot air leak back into the compressing cylinder, it fails to cool the cylinder, and trouble develops.

Other causes for explosions in compressed-air systems are: (1) insufficient lubrication in compressing cylinder (2) too much lubrication. This results in lining the immediate piping from compressor with carbon that ignites from high temperatures of compressed air. (3) insufficient cooling surface or cooling water, in the intercooler of multi-stage compressors, and in the aftercooler.

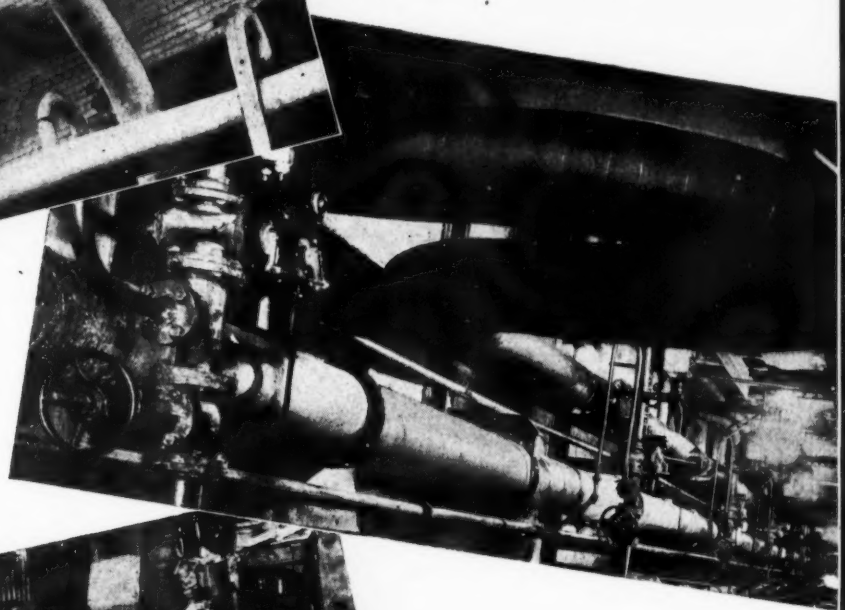
Newark, N. J. R C CONK

PIPING PERFECTS *the* PROJECT



Proper design, layout, fabrication and erection of piping for power and for transmission of materials are imperative for the successful functioning of a process plant.

Successful operation of Blaw-Knox-built plants measures the importance that Blaw-Knox engineers attach to piping installations.



Seven Blaw-Knox plants have been awarded the Army-Navy "E", and have regularly received renewal stars for continued high achievement in the production of war materiel.

These two books constitute a service offered by Power Piping Division. They are written by engineers for engineers and will be sent free to any engineer or major executive who requests them on his own stationery. Ask for FLEX-ANAL CHARTS and Catalog No. 2026.

BLAW-KNOX COMPANY
POWER PIPING DIVISION

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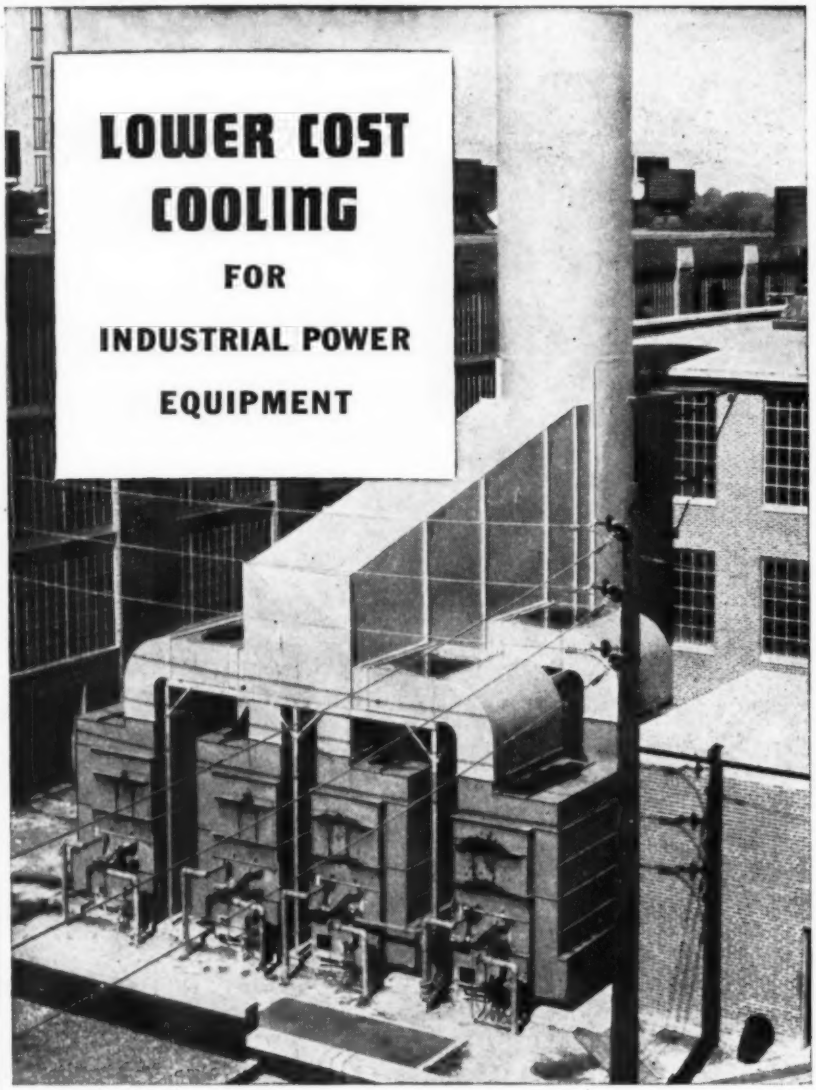

NIAGARA AERO HEAT EXCHANGERS provide a closed system of re-circulated clean jacket water at controlled temperatures and without the consumption of cooling water except for the small amount which is evaporated. Heat is absorbed at the rate of 1000 BTU per pound of water evaporated.

Ample cooling capacity is available in compact, economical equipment. There are additional savings in the cost of piping and pumping.

The operating dependability of NIAGARA AERO HEAT EXCHANGERS is assured by their record of long years of service under the most difficult industrial conditions. Ask for Bulletin 96-P

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NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

New Equipment

(*Continued from page* 138)

reduce flashover danger from moisture and dust accumulations. Heavy guide pins act as ground contacts and align the plug to prevent improper connections.

Telescoping barriers isolate contacts, and increase both surface creepage and air gap between adjacent contacts. The monoblock connector is available in two sizes, *RE*-18*S* for 18 contacts, and *RE*-12*S* for 12 contacts. **Dept P, The Winchester Co, 6 E 46th St, New York 17, N. Y.**

Control Servomotor

TWO-PHASE SERVOMOTOR for remote-control applications can be wound to operate on 10 to 80 v, 60 cycles, but units can be supplied for higher voltage. Core length can be changed, plus or minus 50%, to suit torque requirements. **Dept P, Transicoil Corp, 114 Worth St, New York 13, N. Y.**

Inaccessible Tube-End Roller

ENTERING THROUGH SMOKE BOX or furnace this expander reaches through tube to roll the far end where working space is limited. Device can be furnished with tapered and flaring rollers or tapered ones for expansion only. Split design is particularly adaptable where there is not enough space to insert a one-piece expander. **Dept P, Richard Dudgeon, Inc, 24 Columbia St, New York 2, N. Y.**

Combustion Control

ALL-ELECTRICAL COMBUSTION CONTROL varies coal feed on the stoker. It permits synchronizing several stokers electrically. Control is available for small and medium-sized plants. **Dept P, Canton Stoker Corp, Canton, Ohio.**

Regal Oils

SEVERAL OILS ARE ADDED to the *Regal* oil series, namely (R & O) *AZ*, *F* and *G*. *Regal* oil *AZ* is suitable for hydraulic equipment in sub-zero temperature, while *F* and *G* were developed for mills where rust-and-oxidation-inhibited oils of corresponding viscosity are needed. These oils prevent clogging of oil lines, scoring of journals, and sticking of governors in marine and stationary-turbine installations, as well as rusting and sludging in hy-

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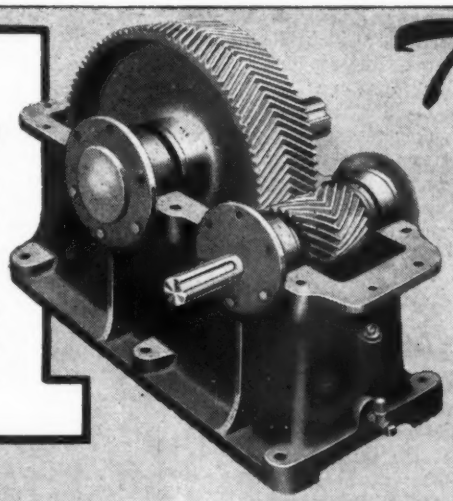
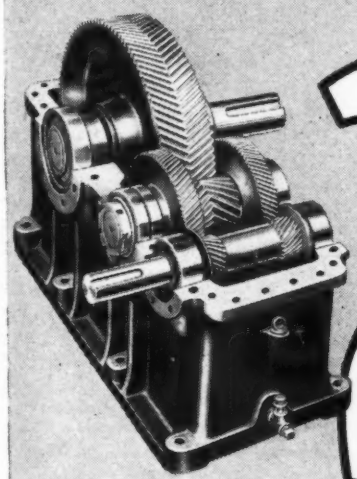
1 SINGLE REDUCTION

Standard Ratios from 1.75 to 1 up to 10 to 1 Ratings from .8 H. P. to 2820 H. P.





2 DOUBLE REDUCTION

Standard Ratios 10 to 1 up to 69 to 1. Ratings from .52 H. P. to 1200 H. P.

These Units are built in three general classes, single, double and triple reduction types, determined by the number of gear trains used. Each type covers a wide range of sizes and ratios. From this complete line practically any equipment can be provided with the right operating speed, as standard ratios range from 1.75 to 1 up to 320 to 1. These units are also suited for speed increasing.

Helical and herringbone type gears give high capacity and efficiency with smooth tooth action. Symmetrical arrangement of gears reduce shaft stresses and eliminates end thrusts. Pinions are heat treated alloy steel, gears heat treated carbon steel. All shafts are mounted on ball or roller bearings. Efficiencies up to 98% are obtained.

3 TRIPLE REDUCTION

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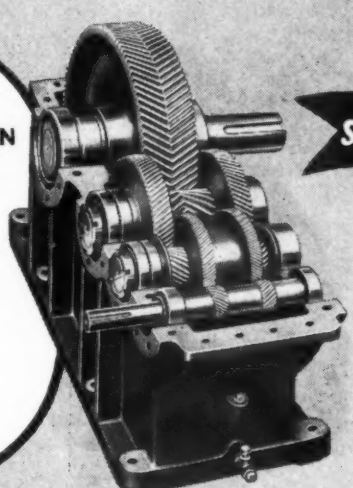
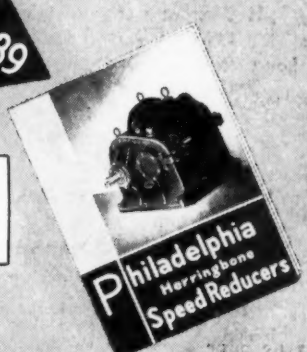


send for catalog H-39

Other outstanding features of these units are explained in our catalog H-39. Write for a copy on your business letterhead.



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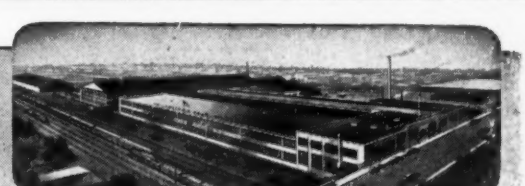

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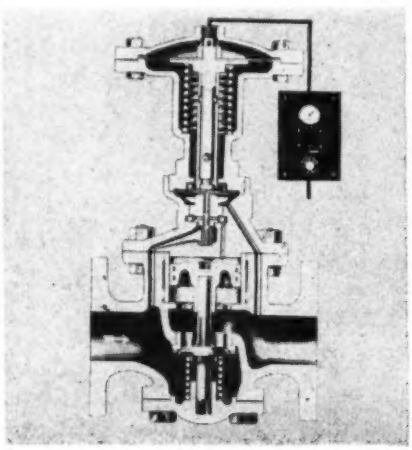
LimiTorque Valve Controls

draulic and circulating systems at both idle and operating temperatures. Oils separate easily from water, do not foam, and are noncorrosive to bearings. The rust inhibitors "plate out" on metal surfaces, forming a film impervious to the rusting action of moisture and air. Even after long service, these oils still pass rusting tests with distilled water and synthetic sea water. **Dept P, Texas Co, 135 E 42nd St, New York, N. Y.**

Extinguisher Hose Reel

CARBON-DIOXIDE HOSE-REEL installation protects hazardous areas that are too large for portable extinguishers or unsuitable for a built-in system. Apparatus contains a special nozzle, handle, shutoff valve, and ample length of hose to fight liquid and electrical fires. Reel accommodates 100 ft of ½-in. hose. **Dept P, Walter Kidde & Co, Belleville, N. J.**



Remotely Adjusted Valve

SINGLE-SEATED REDUCING VALVE equipped with an air-loading panel serves in process or heating systems where the valve is in a hazardous or inaccessible place. Turning control knob on air-loading panel adjusts valve. Valve is *Class LT*-3 and panel type *ARP*. **Dept P, Leslie Co, 255 Grant Ave, Lyndhurst, N. J.**

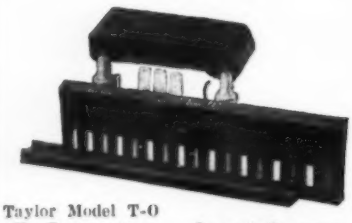
Head-Rest Goggle

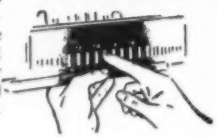
WELDING GOGGLE has eye cups specially designed for wear directly over the eyes or over prescription glasses, and is adjustable to individual features. Indirect, ventilated side-shields keep out stray light rays and sparks, yet provide necessary ventilation. The goggle attaches to the head-gear assembly through a friction joint, which permits easy change from *on* to *off* position. **Dept P, American Optical Co, Southbridge, Mass.**

Core-Loss Tester

DESIGNED TO MEASURE ac permeability and core loss in steel samples, this instrument, a self-contained desk-type unit, fully meets ASTM specifications for measuring core loss and ac permeability at commercial power frequencies and inductions up to

Keep BOILER OUTPUT HIGH!





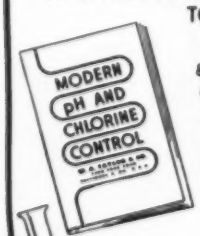
Taylor Model T-O pH Comparator—basic outfit of the Taylor line. All pH slides and many others can be used with this one base.

CHECK YOUR BOILER WATER WITH TAYLOR COMPARATORS

With Taylor Comparators, you may now quickly and easily determine phosphates, pH, nitrates, silica . . . and many other factors which affect steam costs. Check pH and chlorine accurately in sixty seconds . . . most other residuals in less than two minutes. Simply place prepared sample in base, move slide containing color standards until match is obtained and read direct from values engraved on the slide. Each inexpensive outfit is light, durable and completely portable. All Taylor color standards carry an UNLIMITED GUARANTEE AGAINST FADING. The *Comparator you need is in this list*:

pH Comparators covering range 0.2 to 13.6
Long Range pH Comparator
Dalite pH Comparator
Boiler Water Comparator (pH and phosphate)
Water Analyzer
High and Low Phosphate Comparators
Poly Phosphate Comparator
Enslow Slide Chlorimeter
Nitrate Comparator

THIS FREE BOOK TELLS YOU HOW TO MAINTAIN HIGH BOILER EFFICIENCY



88-page book gives applications to many types of power plant needs, illustrates and describes outfits which have proved their worth to men such as you . . . gives full details! See your dealer today, or write direct to:

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Economical . . . easy to use Oakite techniques, specially designed for the work, speedily restore units to full filtering capacity. Oakite compounds may be used effectively in cleaning dry or viscous impingment type filters for unit air conditioners or for central systems, whether the filtering medium is spun-glass, expanded metal, crimped wire, steel wool or wire mesh.

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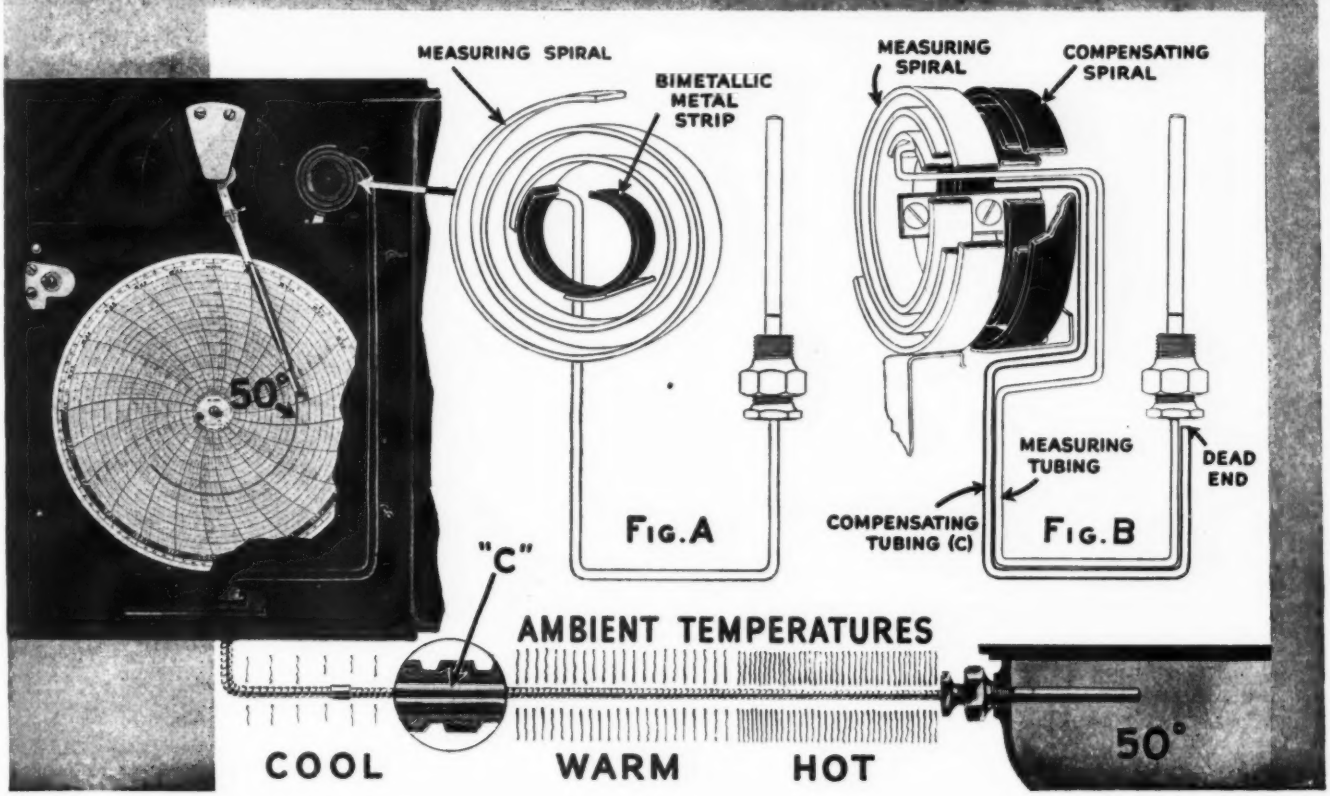
Compensated for AMBIENT TEMPERATURES



PRECISION Recording or Indicating of true bulb temperature is a built-in feature of Brown Thermometers.

Errors due to ambient temperatures surrounding instrument case and capillary system are compensated for at the point of fluctuation.

Brown *Mercury* filled Thermometers (Fig. B) have two spiral actuating elements and two capillary tubes. The *first*, or measuring spiral is connected to the bulb through its capillary in the usual manner. The *second*, or compensating spiral, is connected to its capillary which is dead-ended at the bulb.

The two spirals expand in opposite directions and are connected directly to the pen shaft. Therefore, a change in temperature within the instrument case itself or at points along the capillary tubing will affect both actuating spirals to the same degree and the results will exactly neutralize each other. Thus, errors are eliminated.

Ambient temperatures have a negligible effect on Brown Gas *filled* Thermometers. Case compensation, all that is required for precision measurement, is accomplished by a bimetallic strip shown in (Fig. A).

When you install Brown Thermometers you can rely on their precision — be confident of their dependability.

Other features are fully described in Catalog 6706

Write for a copy, THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Company, 4490 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities.

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MACWHYTE WIRE ROPE SLINGS

It doesn't pay to take chances with clumsy, unsafe, makeshift slings to handle your materials. You can get safe, flexible, easy-to-use Macwhyte Wire Rope Slings made to your own specifications. These superior slings lift loads fast, economically, save both time and labor. Made from our best-grade wire rope. Macwhyte Sling Engineers are at your service.

Send for Sling Catalogs S-7 and 44-1

List Macwhyte's complete sling line. Contain application pictures, much helpful information. See your nearest Macwhyte representative, or write . . .

MACWHYTE COMPANY

2944 Fourteenth Avenue, Kenosha, Wisconsin

MACWHYTE COMPANY 50th Year 1896 – 1946

18 kilogausses. The core-loss tester can be supplied with a power pack that holds constant wave, shape and frequency, or it can be used with a sine wave generator.

Test frames are on left side, writing and drawer space on right. Between the two are an ammeter and voltmeter. Control panel and indicating instrument are on front of cabinet at eye level for easy reading. **Dept P, General Electric Co, Schenectady 5, N. Y.**

General-Purpose Welding Rod

THIS MILD-STEEL ELECTRODE, conforming to AWS classification E-6012 and marked according to NEMA standards, operates well on ac and dc, straight or reverse polarity. The manufacturer especially recommends it for low-cost single- or multiple-pass welding on plates or sections where fit-up is poor, or work rusty or dirty. **Dept P, Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.**

Tachometer Recorder

A LIGHT-WEIGHT INKLESS INSTRUMENT has a typewriter ribbon to record rotating speeds up to 3000 rpm. Readings are accurate to within 1.5% of full-scale deflection. Chart can be run at one, two or three inches per hour, or one inch per day. **Dept P, General Electric Co, Schenectady 5, N. Y.**

Ring Gasket

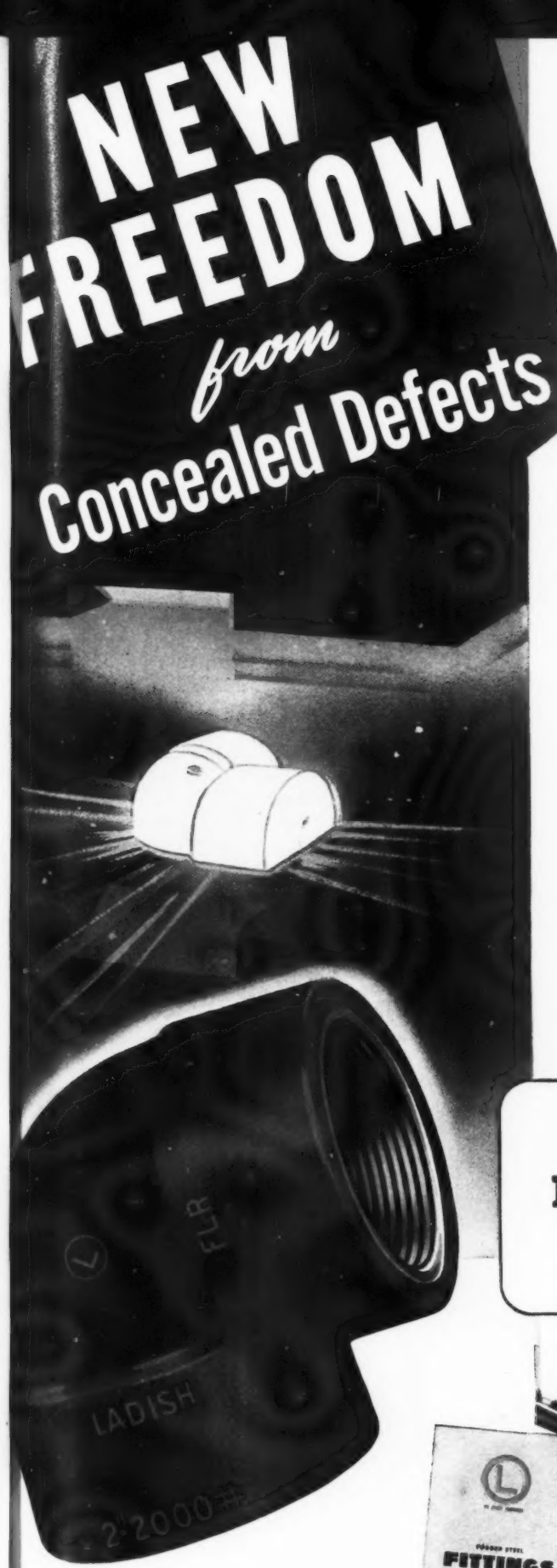
FORGED OF DIFFERENT METALS to meet requirements of various service conditions, this forged-ring gasket can be used for valves, valve bonnets and flanged joints in high-pressure and high-temperature pipelines. It is available in a wide range of sizes, both oval and octagon cross-sections. **Dept P, Steel Improvement & Forge Co, Cleveland, Ohio.**

Overhead Connector

PENTROX, A COMPOUND that penetrates oxide on conductor surfaces, seals them against air and moisture, and is used with *Hysplice* connectors for overhead high-pressure lines. Thus, manufacturer claims,

(*Continued on page* 180)

NEW FREEDOM *from* Concealed Defects



MILLIONS OF HORSEPOWER

developed at impact

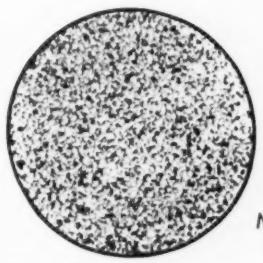
Assure the Soundness of LADISH FORGED STEEL FITTINGS

Up to 20,000,000 horsepower are developed during that split second of impact when one of our giant steam drop hammers strikes the Controlled Quality steel that goes into Ladish Forged Steel Fittings.

These tremendous impact pressures . . . applied when the top quality steel has been heated to correct plasticity . . . produce a denser, more homogeneous metal structure, eliminating the possibility of concealed defects and porosity which can often be the cause of premature leaks and failures.

This soundness that means dependable, trouble-free service is inherent in every Ladish Forged Steel Fitting . . . just one reason why it's *sound* economy always to specify Ladish Forged Steel Fittings for your piping requirements.

A micro section of any Ladish Forged Steel Fitting shows uniformity and refined metallic structure, completely free of defects.



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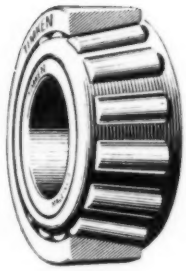
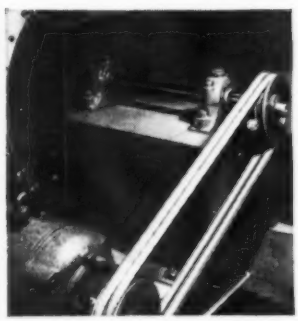


DODGE PUTS TIMKEN BEARING PRECISION INTO *WORKING CLOTHES*



THE DODGE-TIMKEN DOUBLE INTERLOCK PILLOW BLOCK provides a precision bearing assembly, *ready for immediate service.* You simply lock it on the shaft and run at full speed and full load. All the parts required for mounting this bearing are manufactured by Dodge — cast in our foundry and carried through many precision operations on the latest machine tool equipment. Dodge mounts, seals and houses the bearing assembly — with its double row of precision-finished rollers — and delivers it fully assembled, adjusted, lubricated — ready to go to work. The Dodge-Timken Double Interlock is one of the famous Dodge 30,000 hour line, covering a wide range of industrial bearing requirements, and ordinarily is available promptly from distributors' stocks. Look for the Dodge Distributor in your classified telephone directory under "Power Transmission Equipment."

DODGE MANUFACTURING CORPORATION • MISHAWAKA, INDIANA

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THE SYMBOL THAT CAME TO LIFE

The man who wears this symbol gives you the correct answers to your problems in mechanical transmission of power. He is the Dodge Transmissioneer.

Transmissioneering Means Advanced Design in Power Drives

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FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY,
ETCHING COMPANY OF AMERICA, 1520 MONTANA STREET, CHICAGO 14, ILLINOIS

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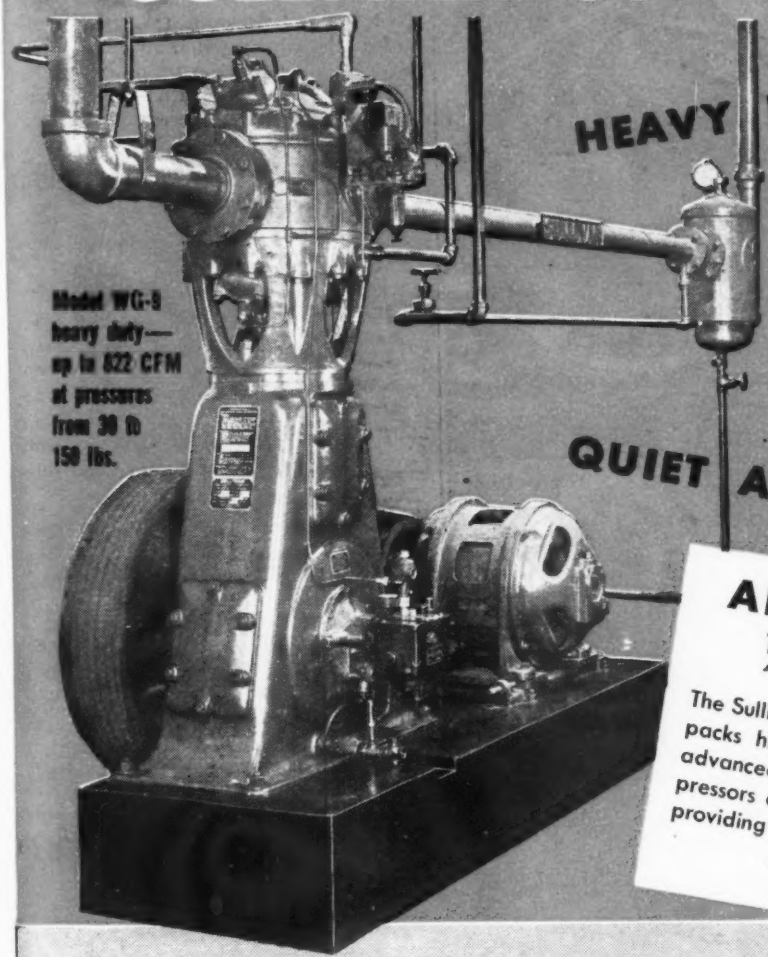
WITH EFFICIENT SULLIVAN COMPRESSORS



Model WG-9 heavy duty—up to 822 CFM at pressures from 30 to 150 lbs.

HEAVY DUTY

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AIR COMPRESSORS
¼ HP to 600 HP

The Sullivan WG-9, like *all* Sullivan Air Compressors, packs high capacity into minimum space through advanced engineering and design. Sullivan Compressors are in satisfactory use throughout industry, providing dependable air power year in and year out.

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AJAX
FLEXIBLE
COUPLINGS
Ajax design permits installation
vertically or at any angle. No lubrication.
Remember that all the horsepower goes
through the coupling...put it up to Ajax.
AJAX FLEXIBLE COUPLING CO. INC., WESTFIELD, N. Y.

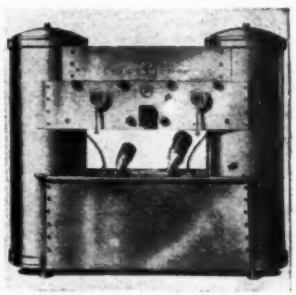
highly efficient connections can be made even on oxidized cables.

Hysplice connectors are readily installed with standard Burndy *Hypresses*, and are available in types for jumper loops and full-tension service. Each connector, as supplied, is filled with *Pentrox* compound and sealed at each end. Cellulose seals are removed on the job and conductors inserted into the *Pentrox* filled barrel in usual manner.

Special dies supplied for *Hysplice* make a circular crimp in the connector, producing low-resistance connection with high mechanical strength. *Hysplices* are available for either aluminum or copper cable. **Dept P, Burndy Engrg Co, 107 Bruckner Blvd, New York 54, N. Y.**

Foam-Generating Nozzle

NEW NOZZLE MECHANICALLY CREATES an airfoam by mixing water, air and *Foamite* air-foam liquid. It extinguishes fire in flammable oils, paints, varnishes, etc. Dual-purpose nozzle can be operated for a foam or clear-water stream by simply removing pickup hose from *Foamite* liquid. **Dept P, American-LaFrance-Foamite Corp, Elmira, N. Y.**



Industrially Pure Water

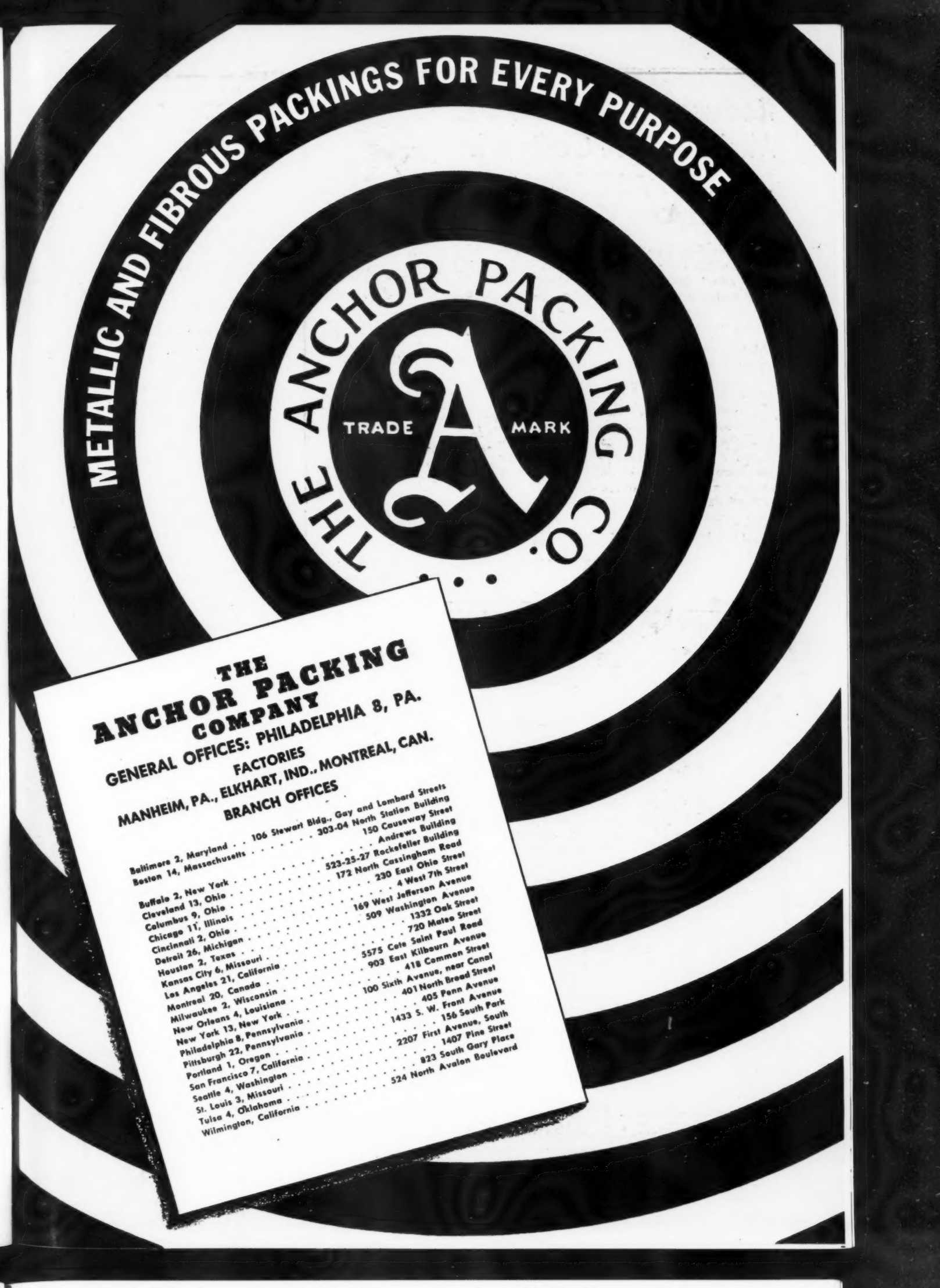
DEMINERALIZING UNIT, designed for plug-in operation from any convenient 110-v 60-cycle source, is constructed so all operating steps are performed and checked on a front-mounting panel. Manufacturer says these complete-package units produce water that can be substituted for distilled water in many industries at lower cost than with a distilling process. **Dept P, Cochrane Corp, 17th St & Allegheny Ave, Philadelphia 32, Pa.**

Stainless-Steel Gate

NONCORROSIVE HOIST-OPERATED stainless-steel gate permits handling acid and corrosive stock. Typical unit consists of wedge gate, for pressure in either direction, with a roller-bearing self-locking hoist as an operating medium. **Dept P, Rodney Hunt Machine Co, Orange, Mass.**

Cutting Torch

FOR REPAIR OF FIRETUBE BOILERS, cutting torch has an over-all length of 13 in. This lever torch can be furnished with a 45-, 75- or 90-deg bronze head. Oxyacetylene cutting torch is particularly adaptable to removal of worn tubes from heating boilers where low-pressure process steam is



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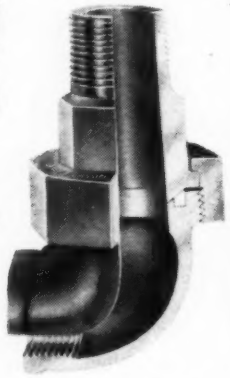
Reduce Installation and Maintenance Costs with

JEFFERSON SPECIALTY UNIONS



Jefferson Specialty Unions are available in types which are designed to simplify piping and effect definite savings in time, labor and materials in making up joints. The 90° Union Elbow illustrated is but one of the many types in the complete Jefferson line.

Maintenance savings, too, are assured through the use of these unions, because fewer joints are involved at points where they can be applied to advantage. The Recessed Brass Seat, an exclusive feature of Jefferson Unions, accounts for ease of installation and maintenance. This seat provides a leak-tight joint without undue pressure and can be made or broken, time after time if necessary, without losing its effectiveness.

. . . the UNION with the RECESSED BRASS SEAT

Your nearest distributor will furnish details . . . or write us direct.

JEFFERSON UNION CO.

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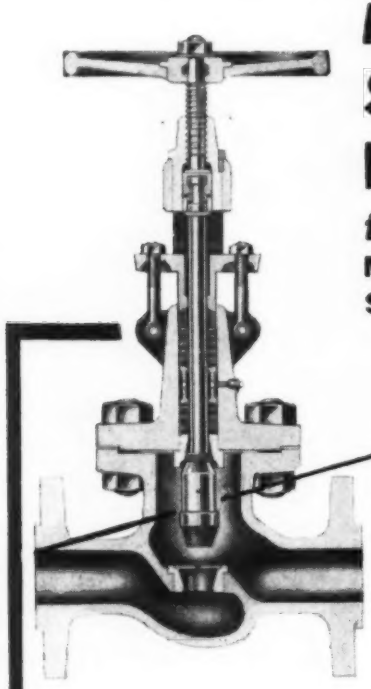
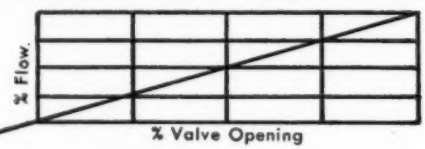


***Install* LUDLOW *SUPERFLOW* MULTI-VALVES**

***for* COMPLETE SHUT-OFF MINIMUM HEAD LOSS AND STRAIGHT LINE THROTTLING**



Scientifically designed Superflow plug and seat, combined with correct streamline body design gives you all three in this one wonder valve.

Built for extra life, LUDLOW SUPERFLOW Multi-Valves actually improve with use, require no regrinding, provide positive stop and throttle action.

SM-1

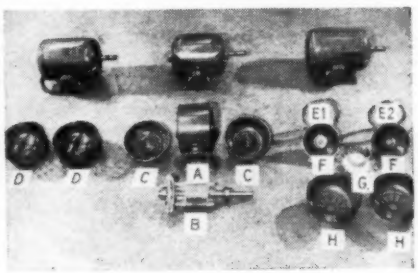
Let us send you illustrated bulletin giving complete information.

The LUDLOW VALVE MFG·CO· SINCE 1866 TROY·N·Y·

required. While easy access is gained to front end of such boilers by opening smoke-box doors, space is usually limited at the rear. This torch permits boiler repairmen to work efficiently in confined space, often in depth as little as 12 in. **Dept P, Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.**

Interchangeable Ac Motors

AN AC MOTOR, known as the *Life-Line*, reduces size by more than 35% without sacrificing electrical properties. Starting torques have been increased as much as 134% per lb of motor, and maximum torques increased as much as 116% per lb of motor. High efficiency and power factors are retained and maintenance requirements are materially decreased. Another feature is bearings that will need no attention for at least five years. Shock resistance is increased many-fold and vibration and noise have been reduced to new low limits. New features in insulating materials and improved winding techniques mean longer life. Rotor is dynamically balanced for smoother, quieter operation.



Several types of motors are attained through extensive interchangeability of parts—an asset of interest to the user. Photo above shows the following three popular types with component parts: splash-proof, open-protected, and totally inclosed fan-cooled. Open-protected consists of stator *A*, brackets *C*, and rotor assembly *B*. To make it splashproof, brackets *C* are oriented with their openings facing upward, and hoods *D* placed over ends. Space between hoods and brackets allows air to enter and leave.

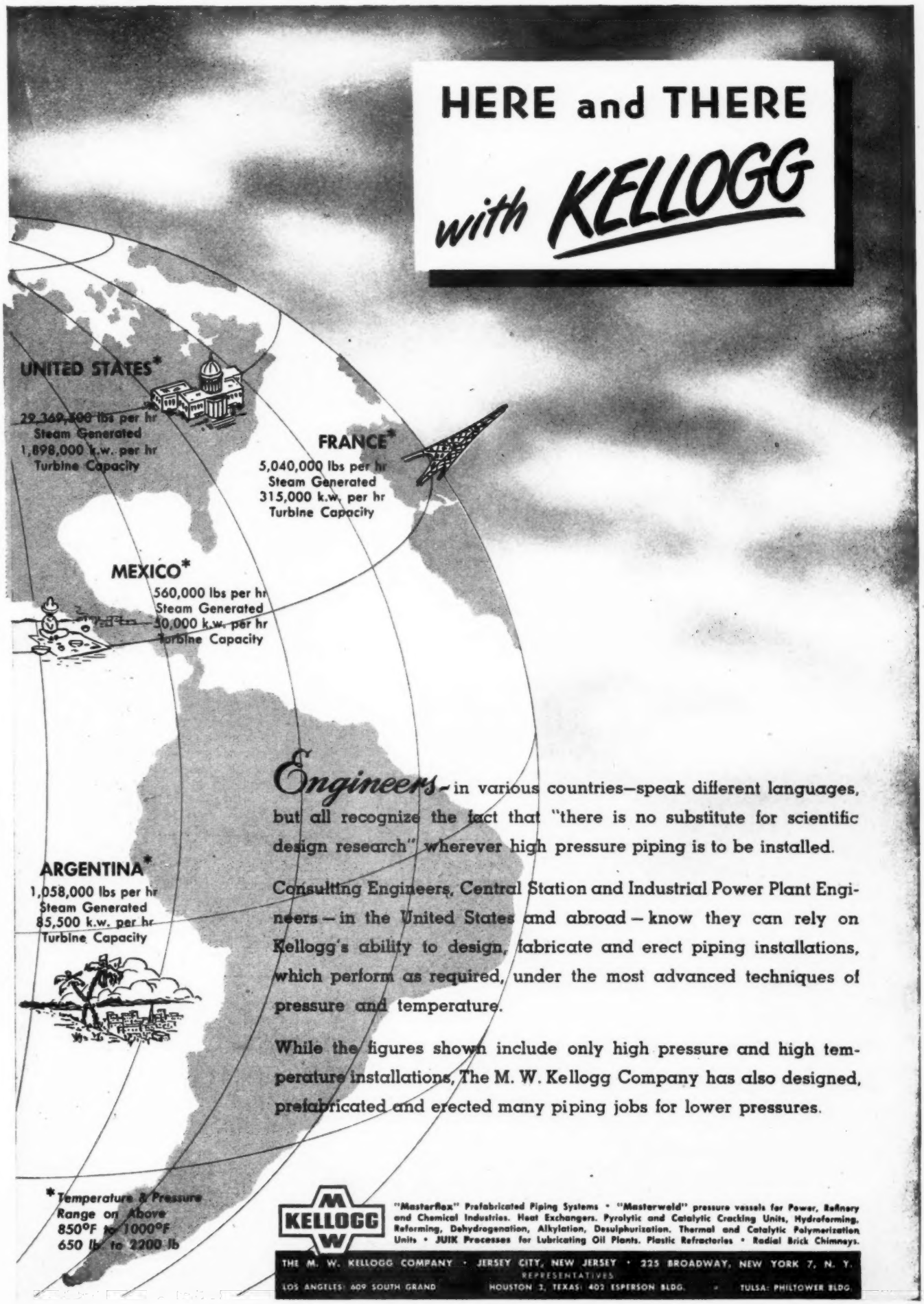
To make a totally inclosed fan-cooled motor, frame *A*, and rotor *B*, without fan, are used with brackets *F*, spacers *E*-1 and *E*-2, blower *G*, and hoods *H*. The brackets seal the inside and support the bearings. Air, pulled in through one hood, is directed between the frame ring and the stator iron, and exhausts out other hood.

Conduit box may be reversed by reversing frames on each type. **Dept P, Westinghouse Electric Corp, East Pittsburgh, Pa.**

Staybolt Studs

PERFECT-FITTING, AUTOMATICALLY WELDED staybolts result from use of Nelson studs and portable welding gun, claim their manufacturer. Studs are inserted through holes drilled or punched in outer shell when it is in place. Welding to inner plates then takes place. Projecting stub end is broken off with a light hammer blow

HERE and THERE with KELLOGG



Engineers—in various countries—speak different languages, but all recognize the fact that "there is no substitute for scientific design research" wherever high pressure piping is to be installed.

Consulting Engineers, Central Station and Industrial Power Plant Engineers—in the United States and abroad—know they can rely on Kellogg's ability to design, fabricate and erect piping installations, which perform as required, under the most advanced techniques of pressure and temperature.

While the figures shown include only high pressure and high temperature installations, The M. W. Kellogg Company has also designed, prefabricated and erected many piping jobs for lower pressures.

M KELLOGG W

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

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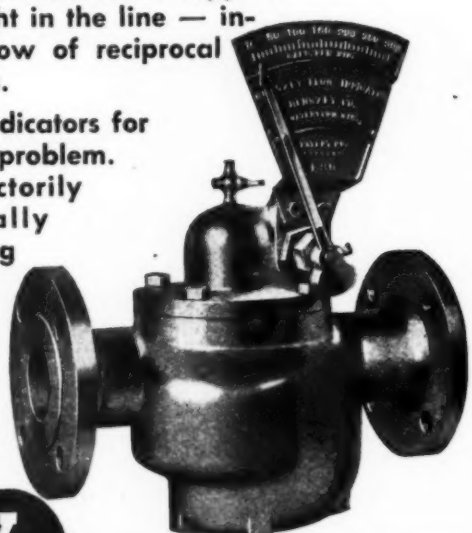
HENSZEY *Flow* INDICATOR

From zero to 100% the markings on the dial of this rugged instrument are spaced in equal units to insure accurate readings at all times. The rate of flow is instantly revealed — no constants are needed to translate readings into the desired information.

There are only three moving parts in the Henszey Flow Indicator — no breakdowns due to complicated gears and mechanisms. No additional supports are needed — it goes right in the line — indicating the pulsating flow of reciprocal pumps exactly as it occurs.

Consider Henszey Flow Indicators for your tough rate-of-flow problem. Installations are satisfactorily performing in nationally known manufacturing plants of all kinds. Send for bulletin FI-1.



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FLOW INDICATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Boiler Feed Regulators • Proportioning Valves
also MILK EVAPORATORS and PRE-HEATERS

on the provided groove. A flat washer dropped over the end is positioned in line with the inner surface of the plate by a shoulder set on the stud. This washer acts as a back-up for final plug-welding to complete the staybolt installation.

An automatic timer controls weld cycle so operator merely loads staybolt stud and ferrule into the welding-gun chuck, and inserts chuck into hole until contact is made with inner plate. He next pulls trigger and the weld is automatically made. **Dept P, Nelson Sales Corp, 28th St at Toledo Ave, Lorain, Ohio.**

Industrial Paints

BLACK, RUST-SEALING industrial paint may be applied direct to rust-covered surfaces without cleaning or scraping. *Rustrem* is reputed to prevent further oxidation even in extreme applications of metal, submerged or exposed to a moist or fume-laden atmosphere. This paint provides a base for decorative paints. **Dept P, Speco, Inc, 3142 Superior Ave., Cleveland, Ohio.**

Seat for Butterfly Valve

A SPOOL-SHAPED RUBBER INSERT forms a seat for valve disk and gaskets for both end flanges of body. Pliant cushion assures tight closure of disk. Temperature ranges from 200 to —20 F. Both heavy-duty and 125-psi units are available. **Dept P, R-S Products Corp, 4530 Germantown Ave, Philadelphia 44, Pa.**

Speed Tool Kits

SEVEN KITS CONTAIN 50 TOOLS, three of which have swivel-bit chucks that give five driving or wrenching positions. Tools include socket wrenches, screwdrivers and set-screw wrenches. **Dept P, Standard Pressed Steel Co. Jenkintown, Pa.**

Hand Tachometer

IMPROVED TACHOMETER has a larger dial which gives longer scale with more room for graduations. Wind vane controls damping device to make damping more effective without causing lag in instantaneous indication of slight speed fluctuations. Accuracy is ½ of 1% at any point on scale. **Dept P. O Zernickow Co. 15 Park Row, New York 7, N. Y.**

Oil Seal Packing

FOR PROTECTION OF BEARINGS, *Clipper Seal*, an oil seal packing, is made with a heel of resin bonded fabric, giving it the rigidity essential for a press fit in the cavity, and with a lip of a tough but soft flexible compound. Special lip design makes it possible to vary bearing area and control lip pressure against shaft by a garter spring, thereby reducing shaft wear to a minimum. Its one-piece precision-made body, concentrically molded and nonmetallic in construction, permits relatively liberal machining tolerances. Its compact shape makes possible a light

WeldELLS

for example:

Tangents

If they did not have tangents, WeldELLS would not have *everything.* These straight segments on each end of every WeldELL achieve three things that only tangents can accomplish:

1. They make lining up easier
2. They keep the weld out of the zone of greatest stress
3. They facilitate the use of slip-on flanges

Providing tangents entails extra manufacturing operations, but this is simply typical of the extra-value you get in WeldELLS and other Taylor Forge Fittings for pipe welding.

A number of these extra-value features are listed here. Note that they are combined only in WeldELLS!

TAYLOR FORGE & PIPE WORKS
General Offices & Works: P. O. Box 485, Chicago
New York Office: 50 Church Street
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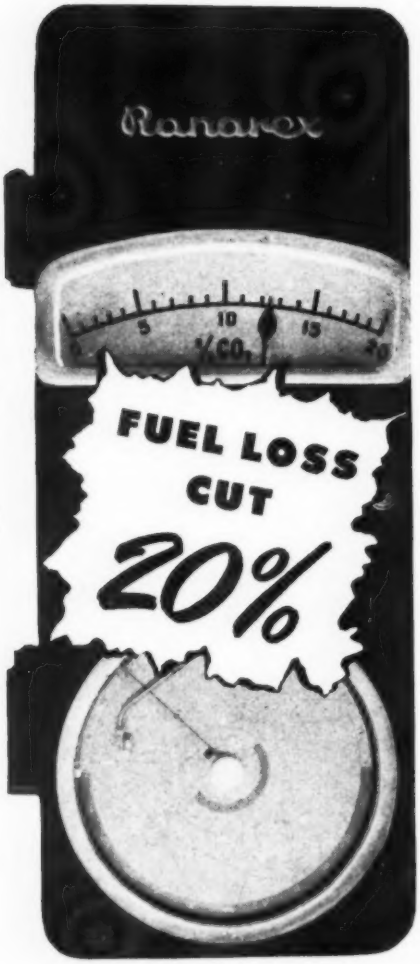
Los Angeles Office: Oviatt Bldg.

WeldELLS alone combine these features:

- **Seamless**—greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends** — simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

have everything



INSTANT CO_2 CHECK

RANAREX* gives a constant, instant check on CO_2 in flue gases—can cut up-the-stack heat loss 20%.

SIMPLE, RUGGED, ACCURATE

And anyone can operate this easy-to-read instrument. It is rugged (contains no chemicals or fragile parts) yet accurate to within 3/10 of 1%.

GET FREE BOOKLET

For an interesting, free booklet on Ranarex, write to The Permutit Company, Dept. PR-11, 330 West 42nd Street, New York 18, N. Y.

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PERMUTIT'S
RANAREX
CUTS UP-THE-STACK HEAT LOSS

flange section that effects compactness of machine design.

Clipper Seal provides a positive lubricant-retaining dirt-excluding seal, automatic in operation, adaptable to a wide range of conditions and highly resistant to most forms of corrosion. *Clipper Seal* is made in sizes for shafts from $1\frac{7}{16}$- to 37-in. dia, in endless and split designs. Special designs are available for unusual temperature, pressure or chemical conditions. **Dept P, Johns-Manville Corp, 22 E 40th St, New York 16, N. Y.**

Electronic Tachometer

DEVICE MEASURES ROTATING SPEEDS from 300 to 50,000 rpm. It consists of a small pick-up head, 6 ft of flexible cable, and measuring unit equipped with an indicator reading directly in rpm. Unit uses two pick-up heads: low-speed head covers five speed ranges, and high-speed one covers three. Pick-up consists of a light-interrupting disk and phototube, which transfers signals to measuring unit. **Dept P, General Electric Co, Schenectady, N. Y.**

Gas Analyzers

DAVIS-HEBLER recorder is said to detect change in CO_2 $3\frac{1}{2}$ sec after flue gas reaches analyzing cell. As this cell is located close to the stack, percentage of change is indicated almost as soon as it occurs.

Employing principle of thermal conductivity, new developments in cell construction permit elimination of continuously operating suction pumps. Flow rate through gas sampling line does not exceed 250 cc per min; minimum flow required is 20 cc per min. This low flow rate eliminates extensive filtering trains and necessity of employing dryers. By a unique arrangement in sampling line, condensate and harmful acids are expelled automatically. The pressure differential between last pass of boiler and stack side of barometric damper is all that is necessary to assure a constant free flow of gas through analyzer cell at desired rate. **Dept P, Davis Emergency Equipment Co, 177 Halleck St, Newark 4, N. J.**

Flow-Rate Instrument

ROTA-TRONIC MEASURES, remotely records, totalizes and automatically controls drop-by-drop flow rates as small as 4 milliliters of liquid per min and, for gases, 20 milliliters per min. The *Rota-tronic*, attached to *F & P Rotameters*, electronically measures float position and, after amplifying the minute electric detecting current, operates large and rugged remote indicators, recorders, controllers and totalizers. **Dept P, Fischer & Porter Co, Hatboro, Pa.**

Centrifugal Pump

CAPACITY OF single-stage double-suction *DBL* centrifugal pumps ranges from 50 to 600 gpm. Maximum suction pressure is 75 psi, maximum discharge pressure 125

Type DA-31 Pressure Control

MERCURY SWITCH
Hermetically sealed mercury switch is used. They cannot be affected by dust, dirt or corrosion; nor are they subject to open arcing, oxidation, pitting or sticking of contacts, all common causes of contact trouble. This switch will give better control service and longer control life.

BOURDON TUBE
(Hidden back of cover)
The Bourdon tube is the actuating element of the control. It is the oldest known, tried and proven element, having been used in gauges for many years.

OUTSIDE ADJUSTMENT
The outside double adjustment with the calibrated dial and pointers is a convenient feature, making it very easy to set the required operating range, plainly visible on the dial. All guesswork is eliminated.

GLASS FACE
The glass face on the cover permits seeing the entire operation of the control in plain view. One can always tell whether the switch circuit is open or closed, a great convenience whenever servicing becomes necessary.

Consult Mercoid on pressure, temperature, liquid level or automatic mechanical control problems.

THE MERCOID CORPORATION
4201 Belmont Avenue
Chicago 41, Illinois

THE ASSURANCE OF DEPENDABLE SERVICE BUILT IN EVERY MERCOID CONTROL

Whatever your

PIPING NEEDS

FILLS THEM QUICKLY-DEPENDABLY

Known Since 1893 for

High Quality

Dependable

Pre-fabrication and Installation

Benjamin F. Shaw Company is qualified to pre-fabricate and erect piping —any place in the United States and Canada.

Benj. F. Shaw III

President

BENJAMIN F. SHAW COMPANY—2ND & LOMBARD STS., WILMINGTON, DEL.

THE PACKING for EVERY PURPOSE

Stops Leaks Prevents Scoring

ALLPAX

This universal packing—consisting of long, tough fibrous asbestos fibres, thin flakes of anti-friction metal, minute graphite scales and a heat-proof lubricant — is recommended for general service against steam, water, air, ammonia, oils, gases, etc., where temperatures do not exceed 600°F. Fits all sizes and shapes of stuffing boxes. Special styles available for high temperature and corrosive liquids, for products, etc. Try it and you'll use it regularly.

Distributors everywhere

THE ALLPAX CO., INC., MAMARONECK, N. Y.

Extra STRENGTH for Heavy Duty

KEWANEE

KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS

• Extra stout stays and braces add further strength to the sturdy steel construction.

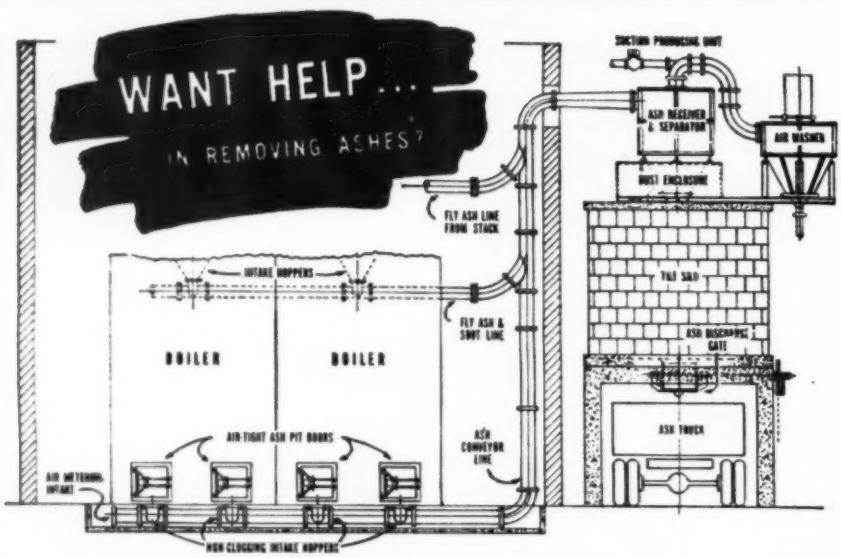
10 to 304 H. P.
100, 125, 150 lbs. W. P.

Has all the characteristics which make firebox boilers especially adapted for high pressure.

WON FOR 5th TIME

75 Years Boilermakers

For 6" scale with pipe diameter markings... WRITE Dept. 96-K11



Get the help you need by installing a Beaumont Birch "Vac-Veyor" pneumatic ash handling system. Labor is saved; cleanliness effected. System time-tested. Low first cost. Low operating cost. Installation as flexible as running a pipe line. Two sizes, two types—for delivering ashes either dry or damp.

For details—write!

BEAUMONT BIRCH COMPANY

1502 RACE STREET PHILADELPHIA 2, PA.

DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

psi, and hydrostatic test pressure 200 psi. Maximum liquid temperature is 300 F. Bronze-fitted pump is standard. Special metals may be furnished for specific services. There is no need for special tools. All internal parts are easily accessible for cleaning or servicing without disturbing piping or alignment.

Pump is available in 1½-, 2-, 2½- and 3-in. discharge sizes in right- or left-hand rotation. **Dept P, Warren Steam Pump Co, Warren, Mass.**

Battery Charger

CHARGER checks battery voltage at regular intervals and makes adjustments accordingly. This selenium rectifier, which gives full wave rectification, has no moving parts. An over-voltage equalizing charge is obtained from a manual switch.

Overload switches or fuses in both ac and dc circuits provide protection for charger and equipment. As battery ages and requires more charging current, automatic age compensator takes care of its needs. Rectifiers provide high resistance to reverse current flow, which keeps battery from discharging in case power supply fails. **Dept P, Control Corporation, 718 Central Ave, Minneapolis, Minn.**

Pipe Pusher

BIG JOE PIPE PUSHER is ideal wherever gas, water or conduit pipe must be put underground. Small and powerful, *Big Joe* deflects most small obstructions. For immovable objects, either a new course can be started to bypass the obstruction or a hole dug at point of obstruction to eliminate it. Total weight is only 45 lb. **Dept P, Construction Equipment Co, Kalamazoo, Mich.**

Welding Fittings

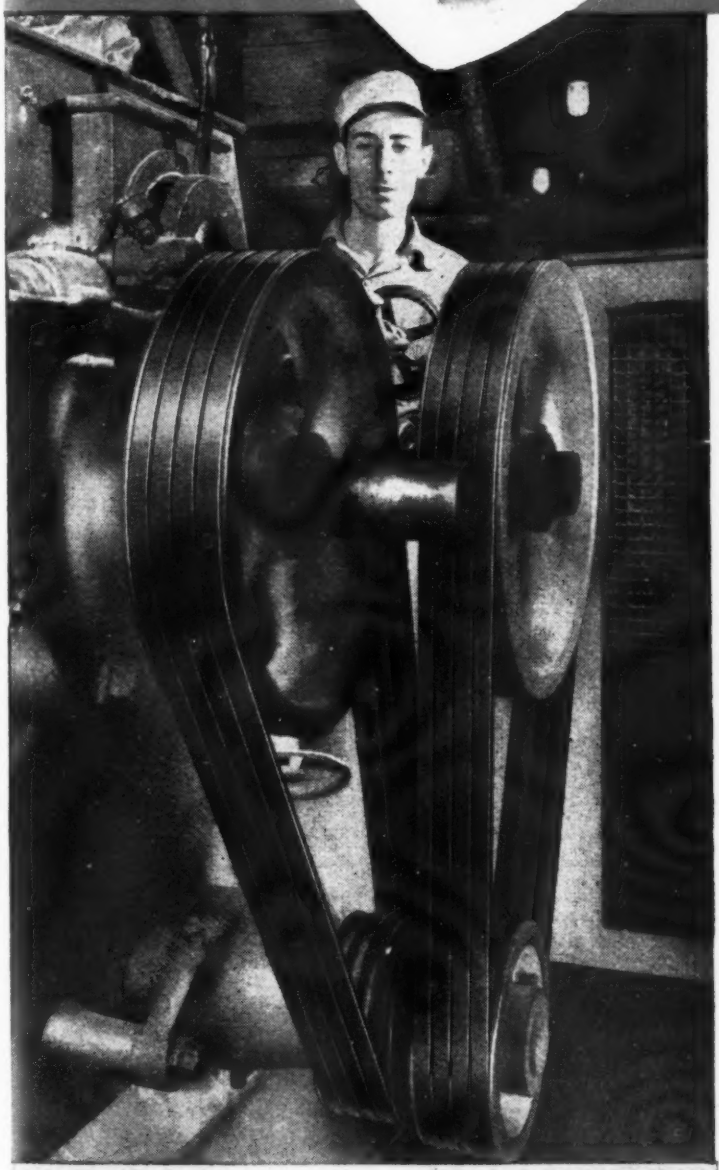
LINE OF STAINLESS-STEEL welding fittings includes 180-deg long-radius returns, 90-deg long-radius elbows, 45-deg long-radius elbows, straight tees, reducing-outlet tees, caps, eccentric reducers, concentric reducers, lap-joint stub ends, laterals and crosses, all in standard and extra-heavy weights; and welding neck flanges, slip-on flanges, threaded flanges, blind flanges, socket-welding flanges, reducing flanges, orifice flanges and lap-joint flanges. Sizes range from ¾ through 12 in.

Fittings may be had in three grades of stainless steel: Type 304, containing 18% chromium and 8% nickel; type 347, containing 18% chromium, 8% nickel and about 1% columbium; and type 316, containing 18% chromium, 8% nickel and 2% molybdenum. **Dept P, Tube Turns Inc, Louisville, Ky.**

Georgia Power Co announced through W E Mitchell, president, a $47,000,000 program to (1) construct a 50,000-kw plant at Albany (2) add a 40,000-kw unit with necessary boiler at the Arkwright plant near Macon and a 60,000-kw machine and a 600,000-lb-per-hr boiler at Atkinson plant near Atlanta.

DAYTON V-BELTS eliminate slippage

KEEP WHEAT GRINDER OPERATING AT TOP EFFICIENCY



In one of the country's large flour mills a huge machine grinds 8000 bushels of wheat per hour. The original belts on the power drive of this grinder gave considerable trouble because they slipped, reducing the speed of the grinder. All too frequently the belts slipped completely off the pulleys, stopping the grinder. Then Dayton V-Belts were installed. Since then the grinder has not stopped once due to belt failure, and slippage has been completely eliminated. More flour per hour is the result. Dayton V-Belts transmit power positively because they are engineered for their job. Their scientific design makes them seat themselves firmly in the pulley grooves and the harder the pull, the more firmly they seat. There is no chance for slipping! Dayton V-Belts are the result of more than 40 years of research and manufacturing experience building products of *specialized* rubber for specific industrial jobs. It is experience that can help you solve your power transmission problems. Write today to The Dayton Rubber Manufacturing Company, Dayton 1, Ohio.

Attention Power Transmission Engineers

There is a mill supply house near you that stocks Dayton V-Belts. A representative of this organization will gladly discuss your power transmission drive problems with you. Look for the name under the trade name listing "Dayton V-Belts" in the yellow pages of your telephone book.

WRITE FOR THE DAYTON No. 280 CATALOG

The Dayton Catalog No. 280 contains 384 pages of tables and other information that makes it possible to select V-Belts for any power transmission drive quickly and accurately. It's free. Write The Dayton Rubber Mfg. Co., Dayton 1, Ohio.

Dayton Rubber

REG. TRADE MARK THE DAYTON RUBBER MFG. CO.

THE MARK OF TECHNICAL EXCELLENCE IN SYNTHETIC RUBBER

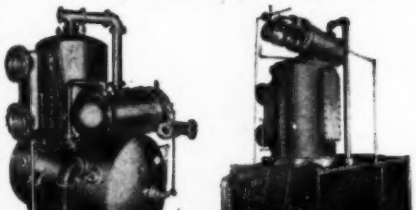
THE WORLD'S LARGEST MANUFACTURER OF V-BELTS

3-WAY SAVING
WITH STICKLE EQUIPMENT

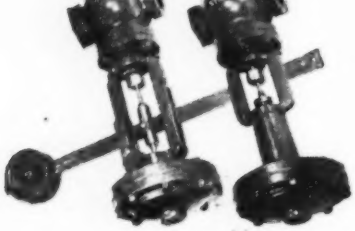
Save in Heating and Purifying Feed Water . . . Save in Closer Control and More Effective use of Steam . . . Save by Avoiding Waste of Heat Units in Condensate from Processing Units

STICKLE OPEN COIL FEED WATER HEATERS AND PURIFIERS

● Stickle Open Coil Heaters supply these advantages: (1) Rapid heating through instantaneous transfer of heat from steam to water. Boiler feed delivered to pump at temperature within two degrees of saturated steam in heater. (2) Release of non-condensable gases. Feed water guaranteed to contain not more than .03 cc. of oxygen per liter. (3) Removal of large quantities of lime and other scaleforming substances. (4) Fully one-sixth of total boiler supply pure distilled water. (5) Automatic control of admission and overflow. . . . Ask for Bulletin No. 117 for complete information.



STICKLE REGULATING AND REDUCING VALVES

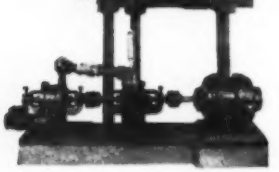


● Stickle Valves — made to meet specific operating conditions — are accurate, sensitive, and dependable. They meet all requirements for complicated pressure regulation and exacting control, being especially designed for use where control of pressures within extremely close limits of variation is essential. Simple. Compact. Easy to install. All parts renewable. Two series, in small to large sizes. Specifications and engineering data in bulletins . . . Series 200 Double-seated Semi-balanced Valves, Bulletin No. 235. Series 400 Single Seated, Balanced Valves, Bulletin No. 435.

STICKLE OPEN FLOAT STEAM TRAPS

● Stickle Steam Traps supply efficient drainage and are trouble-free. The Stickle Open Float principle provides for simplicity of design and natural operation. It eliminates complicated internal mechanism and makes for easy, positive, effective performance. There is no friction, no sticking, no unnecessary parts to wear out. Service life is long, maintenance negligable. Built in four series designs to meet specific operating conditions and requirements. . . . State type of equipment, operating pressure, and quantity of condensate to be handled for recommendations.

STICKLE DIFFERENTIAL DRAINAGE and BOILER RETURN SYSTEM



● This system reduces fuel consumption up to 20 per cent. and increases boiler capacity in ratio to fuel saving. It permits condensate to be returned directly to boilers, under pressure, at a temperature only 15 to 20 degrees lower than steam at operating pressure. Its use improves the quality of steam and supplies correct drainage for processing equipment. It decreases maintenance by reducing boiler scale and eliminating high velocities through traps. Minimum savings are predetermined and guaranteed. Actual savings made for many industries such as canning plants, laundries, and paper board mills usually have exceeded estimates, and extra advantages have been greater than anticipated. Ask for Bulletin No. 250.

Other Stickle Specialties include Temperature Control Valves, Oil and Steam Separators, Blast Coil Heaters and Heat Reclaimers

STICKLE STEAM SPECIALTIES COMPANY

2265 VALLEY AVENUE, INDIANAPOLIS 1, INDIANA

SPECIALIZING FOR MORE THAN 40 YEARS IN REDUCING THE COST OF STEAM

Power News

(*Continued from page* 148)

and capable elements in this field.

"For this reason, it has decided to engage the services of eminent American engineers and capable Mexican engineers among whom are the following personalites: In the first group:

"Edward Falck, former director, Office of War Utilities Administration, and now a consultant; Walker Cisler, who also served in said Office and directed the reestablishment of electric services in Europe, at present chief engineer of the Detroit Edison Co plants; Herbert S Marks, expert of the American Government in the Office of War Utilities Administration, and at present connected with the State Department of the American Government in one of the important commissions studying nuclear energy; Charles A Collier, vice-president, Georgia Power Co, who also served with the American Government during the war and who is recognized as an expert in selling and utilization of electric energy; Eli M Williams, chief engineer of various electric enterprises in the United States, and during the war managing engineer of the Corpus Christi Naval Air Base; James D Mamarchev, engineer, Dow Chemical Co, who has achieved various important engineering works, and who during the war worked in the construction of the magnesium plants set up in Texas.

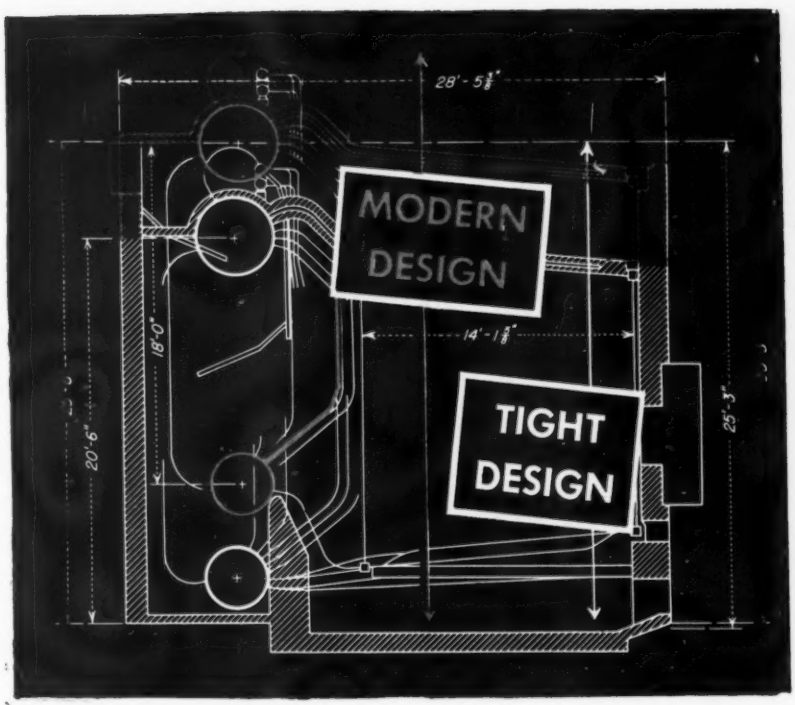
"In the group of Mexican engineers are: Ingeniero Aurelio Benassini, director, Studies and Projects, National Irrigation Commission, who has a very wide experience in engineering work and in the current characteristics of the Mexican rivers; Ing Andres Garcia Quintero, one of the best hydrological experts of Mexico, serving with the National Irrigation Commission; Ing Victor Manuel de la Pena, for many years connected with the public-utility companies of the country and an expert in protection systems and connecting of electrical plants and installations; Ing Manuel Artola, engineer on operation of the electrical plants of Paris, expert in operation of thermo-electric plants; and a group of Mexican aides, made up of young men for whom the experience consisting in reorganizing Mexico's electric works and installations will represent first-class training.

"The mobilization plan will be directed and coordinated by Ing Oscar R Enriquez, General Director of Electricity, acting under direct orders of the Minister of National Economy, Ing Gustavo P Serrano."

Defining "FLEXIBILITY"

TIGHT DESIGN–restricted fuels
MODERN DESIGN–fuel flexibility

DESIGN SPECIFICATION The Design Specification should give the critical characteristics of typical fuels which will be economically available during the life of a new Power Plant. A leading equipment manufacturer selects Ash Softening Temperature as a controlling factor, and says, *"The basis of modern boiler and furnace design is to so proportion the furnace and cooling surface in the furnace that under average conditions of furnace wall cleanliness, the temperature of the gas entering the boiler surface will be below the ash fusion temperature."*



RANGE IN QUALITY The Fuel Investigation develops the range in fuel quality which should be planned for. This manufacturer shows here a "tight design" requiring the use of restricted fuels, and outside of this he shows a "modern design" with a larger furnace so proportioned that a wide range of fuels can be used.

FLEXIBILITY Sound planning requires that new or modernized power plants provide sufficient latitude to permit the utilization of the range of coals competitively available during their useful life. In so doing, Utilization Flexibility is achieved.

FAIRMONT COAL The Fuel Investigation reveals that Fairmont Coal will probably be an excellent value in many markets for many, many years. Utilities and Industrials are using Fairmont Quality as the design basis for new power plants.

Designing for Fairmont Coal permits the use of a wide range of fuels. Initial investment for flexibility is somewhat higher, but the additional cost can be quickly amortized and permanent savings are possible through the use of the best fuel value available.

MAIL COUPON TODAY

FAIRMONT COAL BUREAU · FAIRMONT REGION · WEST VIRGINIA · SERVICE TO INDUSTRY

FAIRMONT COAL BUREAU, Chanin Bldg., 122 E. 42nd St., New York 17, N. Y.

Write for Reference Bulletin No. 5 for the details on investment required for flexibility in plants requiring 400,000#, 200,000#, or 60,000# of steam per hour. Your request will automatically put your name on our mailing list. P-11-46

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Make Your Overhead Valves SAFE and Easy to Reach---

With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.

New Bedford, Mass.

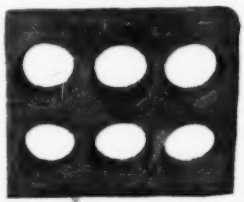
Don't WAIT 6 WEEKS OR LONGER . .

USE

ADACAST

for SPECIAL FIRE CLAY SHAPES:

ADACAST, a castable refractory, pours like concrete . . . is so easy to use . . . that unskilled plant labor can produce uniformly fine results . . . in actual size forms . . . economically and efficiently.



Burner Block made with ADACAST. Forms were made to actual size . . . because of minimum shrinkage and expansion.

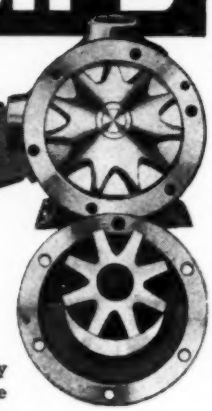
BOTFIELD

REFRACTORIES CO.

784 S. Swanson St., Philadelphia 47, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

VIKING PUMPS

WIDE OPEN



For YOUR Inspection

Know VIKING PUMPS and you know why they are rugged . . . simple . . . dependable. There are no blades, springs, gadgets, timing gears or a mass of other devices required to make them work or help improve and retain efficiency.

The VIKING is simple . . . just 2-moving "gear within a gear" parts make up the pumping principle. That is why they work so well for pumping fuel oil, lube oil, water, etc. They are self priming without pulsation . . . deliver against discharge pressures up to 50 - 100 - 200 - or 500 psi, depending upon construction and applications.

Know VIKINGS and what they can do for you. Send for free bulletin 46SW today.

See Our Catalog In SWEETS

VIKING PUMP COMPANY

CEDAR FALLS, IOWA

Power and Process Highlight National Show

Early reports from a list of nearly 400 exhibitors at the 17th National Power Show, Grand Central Palace, New York, Dec 2-7, indicate their belief that all industries are power consumers.

Considerable effort is being made to show various means of applying power to production. Processing services, such as fuel, heat, steam, air and water supplies and materials handling, come in for display.

Valve manufacturers, for instance, will offer interchangeable parts of various metals in otherwise standard units to permit handling different fluids under different pressures and temperatures.

Included among exhibits designed for process industries are air-hydraulic presses for materials and assemblies suited for process purpose: high-pressure pumps applicable to boiler feed, along with pumps for injection molding and die casting.

Bituminous Coal Research, Inc granted contracts to Allis-Chalmers Mfg Co and Elliott Co for one locomotive gas turbine each to operate with pulverized coal. The 3750-hp units are to mount on single cabs no longer than those used for present-day standard locomotives. Elliott states that their unit will deliver 3000 hp at the rails. Allis-Chalmers claims an approximately 24% shaft efficiency.

Walker Mason, executive vice-president, **Narragansett Electric Co** announced a $7,000,000 project for installation of a 40,000-kw turbine unit with steam-generator and coal-unloading equipment at the Manchester St station, Providence, R. I.

Western Massachusetts Electric Co, Springfield, plans a new steam plant of 40,000 kw on the Connecticut river in West Springfield. J W Bennett is chief engineer and W D Packard, superintendent of power for the company.

Vice-president A N Cartwright, **West Penn Power Co**, announced the proposed construction of a steam power plant on the Monongahela River near Courtney, Pa. The new station, 80,000-kw initial installation, will be called the Mitchell station in honor of the company's president, H L Mitchell.

Kennedy-Van Saun Mfg & Engrg Corp recently presented to 35 employes at Danville, Pa., a letter of appreciation and a gold pin, signifying 25 years of service. J E Kennedy, president, and Fred O Reedy, vice-president and general manager, were included.

Babcock & Wilcox Tube Co purchased the welded-boiler-tubing plant at Alliance, Ohio, from the War Assets Administration for $1,315,794.50. Plant, erected at Government request in 1942, has been operated by the tube company since its erection, stated Peter D White, vice-president and general manager.

SQUARE-Duct *offers...*

Flexible **POWER DISTRIBUTION**

MODERATE INITIAL COST

SPEEDY, LOW-COST INSTALLATION

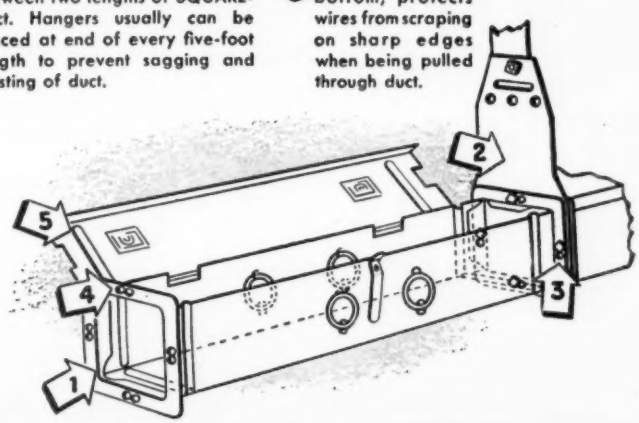
100% SALVAGE FOR RE-USE

Power where you want it—when you want it—without buying or moving long runs of conduit.

That's why so many plants use SQUARE-Duct to carry feeders, branch circuits, and other groups of conductors. SQUARE-Duct saves time and money every time a machine is moved or a new one added. Knockouts every three inches along the duct provide complete flexibility of machine location. Circuits are easily accessible for inspection or maintenance.

The initial cost of SQUARE-Duct is comparable to that of conduit wiring. Installation cost is substantially lower. For complete details . . . call your Square D Field Engineer, or write Square D Company, 6060 Rivard Street, Detroit 11, Michigan, for Bulletin 6000.

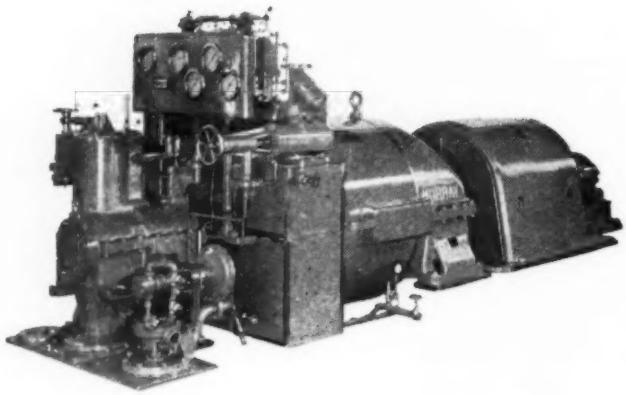
1. Drawn collar affords secure support for the duct and automatically aligns each length to prevent twisting. It also serves as a stable connection to the adjacent length equipped with a similar collar.
2. Notice how hanger fits securely between two lengths of SQUARE-Duct. Hangers usually can be placed at end of every five-foot length to prevent sagging and twisting of duct.
3. Hanger is bolted to both sides, top and bottom, affording even distribution of weight and offsetting any tendency to twist.
4. Double keyhole screw slots help in making alignment adjustments.
5. Emboss on cover, both sides and bottom, protects wires from scraping on sharp edges when being pulled through duct.



SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

MURRAY
STEAM TURBINE GENERATING UNITS



Installed in 1939 in a small municipal power plant in northeastern Indiana, the above 500 KW direct connected Murray steam turbine generator set has given its owner entire satisfaction. The turbine is equipped with every device necessary for minimum of attention including steam turbine driven auxiliary oil pump. The generator and exciter may be furnished to match existing electrical equipment in your plant.

Units in this size may be furnished either direct connected or geared as preferred with performance and operation equally trouble-free.

There is a Murray representative ready to help you with design and layout information.

MURRAY *also produces*

Mechanical Drive Turbines — Horizontal and Vertical Reduction Gears of the high speed type Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

New Standards for Fractional Motors

National Electrical Manufacturers Association has announced a standardization program for fractional-horsepower motors.

New standards define motor rating and performance in terms of horsepower rating, speed, breakdown torque and service factor. Included in the fundamental standards are previously standardized locked-rotor or starting currents of motor.

Work to date constitutes only the first phase. Later, standards will be set on dimensions and applications for such motors as hermetically sealed units, belt-driven refrigerator compressors, washing machines, stokers, oil burners, belted fans and blowers, gasoline pumps and jet pumps.

M J McHenry, director of promotion, **Ontario Hydroelectric Power Commission,** stated recently that house heating by electricity to serve an estimated 5% of Toronto homes would amount to a third the power used for all purposes. In addition, cost of equipment and its installation makes any such proposition uneconomical.

Ontario Hydroelectric Power Commission will complete its $10,000,000 hydro plant on the Madawaska River at Stewartsville, in the latter part of 1947. Three generators with 27,000-hp capacity each will supply 60-cycle power.

British Columbia Power Commission has begun surveying for a $100,000 development on Cayoosh Creek, near Lillooct, B. C.; 1200 hp is expected to be in operation by next spring.

H G Acres and Co, consulting electrical engineers, reported that a 75% increase in electrical demand (from 225 to 400 million kwhr per year) would enable a proposed $25,000,000 hydro project to compete successfully with steam-generated power. Proposed site is 60 miles east of Prince Albert on Saskatchewan River, Canada.

Baldwin Locomotive Works, Eddystone, Pa., received a $2,199,586 contract for five 94.7-rpm vertical-shaft hydraulic turbines to drive five 45,000-kw generators to be installed at the Davis Dam, on the Colorado River between Arizona and New Mexico. First delivery must be shipped in 20 months with succeeding units to follow at 2-month intervals.

Lyles Ford Tri-County Power Authority has applied for a preliminary permit to the FPC for a 3-dam hydroelectric development with a supporting 60,000-kw steam station. Proposed dams are (1) 39,000-kw Columbia, on the Congarie at Columbia, S. C. (2) 108,000 kw Blair, on Broad River at Blairs, S. C. (3) 96,000-kw Frost Shoals on the Broad, six miles above Columbia. FPC's announcement said development would be aimed at serving "the populous, industrial Piedmont section of North Carolina." Columbia is now served by South Carolina Electric and Gas Co.

Yours FOR THE ASKING

Water-vapor refrigeration is the ideal method of cooling water down to temperatures as low as 35°F.

Operated by steam, such coolers are inherently simple, safe, quiet and clean.

If you have cooling problems in which 20 or more tons of refrigeration are required, you should have a copy of this bulletin.

Ingersoll-Rand

11 Broadway, New York 4, N. Y. 13-825

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Please send me a copy of your Water-Vapor Refrigeration Bulletin, Form 9143-A.

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withstands heaviest traffic

No matter how heavy the loads —nor how hard the traffic— Hendrick Mitco Armorgrids never require replacement. Completely fabricated units, Mitco Armorgrids require no bolts, rivets or assembly work. Neither do they depend upon fill for development of full strength in resistance to shock loads.

Unequaled for floors, platforms and ramps that have to withstand grinding loads, heavy shocks and continuous wear. Write for full information.

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Manufacturing Company

Perforated Metals
Perforated Metal Screens
Architectural Grilles
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"Shur-Site" Treads and
Armorgrids

46 DUNDAFF STREET, CARBONDALE, PENNA.

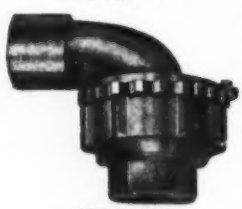
Sales Offices In Principal Cities

A MOVING FEED LINE IS NO SAFER THAN ITS FLEXIBLE JOINT

—for dependability . . . use

FLEXO JOINTS

STYLE "A"



STYLE "B"

STYLE "F"

STYLE "H"

In every moving feed line used to convey steam, compressed air, and other fluids, the safety and efficiency of the operation depends greatly on the efficiency and safety of the swing joints that are used.

For this reason, Flexo Joints, the time-tried and job-tested, safe, dependable swing joint is preferred and specified by engineers in all types of plants throughout the world.

No restriction and full flow through pipe lines at all angles, with Flexo Joints. Swivel through 360°. Flexo Joints require minimum maintenance and give virtually trouble-free service. Available in 4 styles and in standard pipe sizes from ¼" to 3". Write for additional information.

FLEXO SUPPLY COMPANY, Inc. 4224 OLIVE ST. St. Louis (8).

In Canada: S. A. ARMSTRONG 115 Dupont St., Toronto (5), Ontario

Industrial Ventilation Subject of Research

A recent survey of 200 people interested in industrial ventilation brought back 113 replies requesting more factual, dependable data on design. Less than half reporting had any such data and only one in three knew of any code or standard pertaining to control of industrial atmospheric pollution by ventilation. Of the groups reporting only the following possessed any design data: about half the official industrial hygiene agencies, less than half the consulting and architectural engineering firms, and only an isolated few among the universities.

To meet this need for data the American Society of Heating and Ventilating Engineers and the U. S. Public Health Service have combined their interest in the subject and inaugurated a long-range research program. Dr A D Brandt of the U. S. Public Health Service was assigned to the ASHVE research laboratory to correlate the activities of the two contributing organizations.

LENINGRAD (*McGraw-Hill World News*)— First of six 102,000-hp hydro turbines for the Dnieper station should be ready for installation by the year's end, it was learned at Stalin Metal Works, Leningrad, USSR. Turbine will be 12,000 hp more than original design but will be housed within the same over-all dimensions.

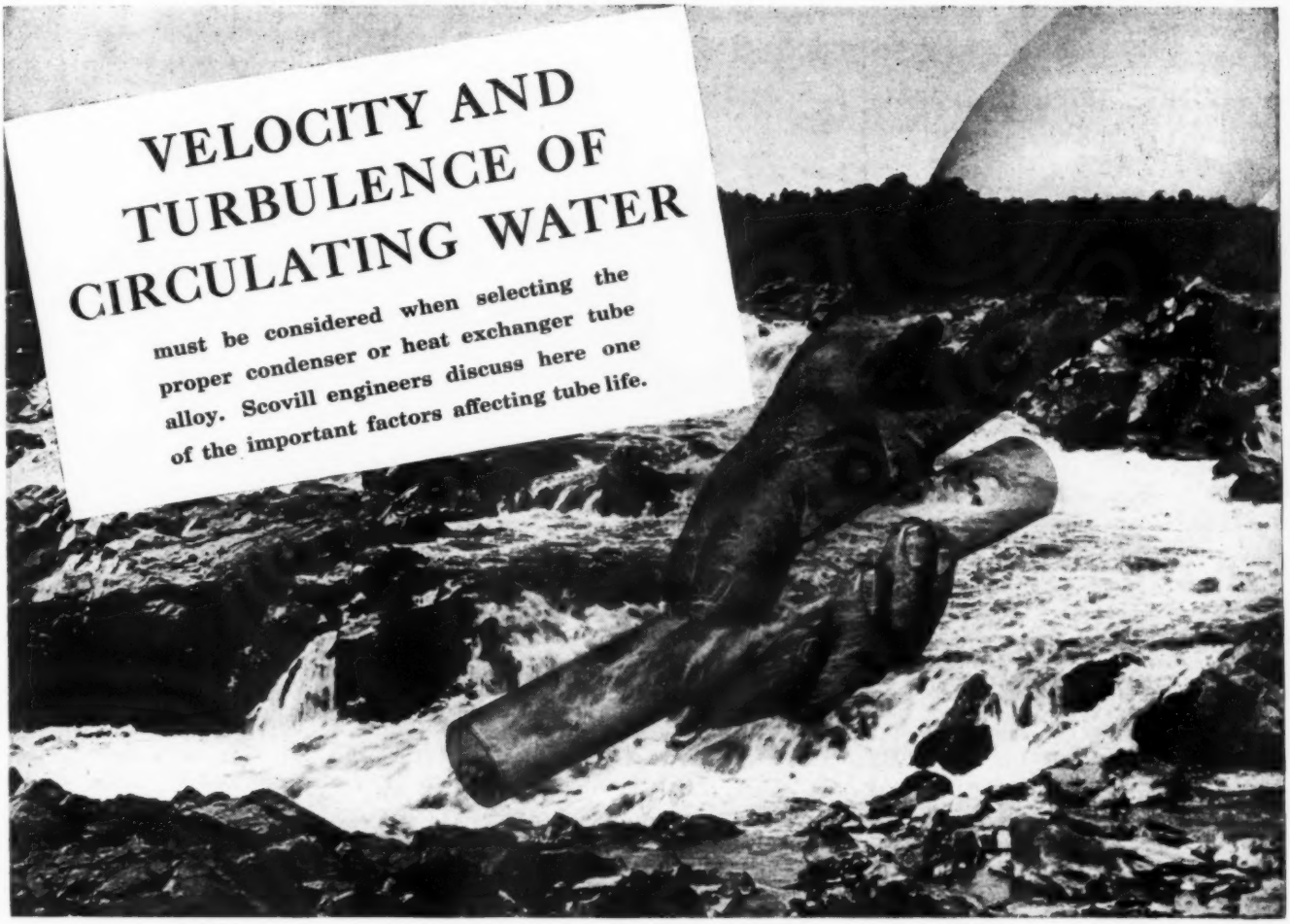
Federal Power Commission applications include (1) Savannah River Electric Co, Charleston, S. C., for a power project on the Savannah River near Clarks Hill, S. C. about 22 miles above Augusta Ga. (Plans call for initial capacity of 160,000 hp and ultimate capacity of 375,000 hp.) (2) Ohio Fuel Gas Co, Columbus, O., for extensions and additions to its facilities for handling more natural gas from United Fuel Gas Co.

Peabody Engineering Corp has additional plant facilities for their Stamford, Conn., works now under way. New facilities constitute a part of the company's long-range expansion program.

Cleveland Electric Illuminating Co announces through its president, Elmer L Lindseth, a new 3-year (1947-1949) $30,000,000 construction program. First project is a 90,000-kw generator and suitable steam-generating equipment.

G C Derry, vice-president and also general manager, **B F Sturtevant Co** div of Westinghouse Electric Corp, announced an expected production of industrial refrigeration and air-conditioning equipment double that of the best prewar year.

Ohio Edison Co announced through Samuel Stites, vice-president, a proposed addition to the Beech St, Akron, O., plant. A new 90,000-lb-per-hr steam generator will be added to the four now in operation. Addition has been made necessary by increased demands for the central steam-heating service now provided.



VELOCITY AND TURBULENCE OF CIRCULATING WATER

must be considered when selecting the proper condenser or heat exchanger tube alloy. Scovill engineers discuss here one of the important factors affecting tube life.

High velocity and turbulence of the circulating water, especially if entrained air or abrasive material is present, tend to promote tube attack of the erosion-corrosion type. In this type of attack the original corrosion product, which otherwise might act as a protective film, is worn away as fast as it is formed, exposing bare metal for further corrosion.

In actual operating conditions, where velocity and turbulence of the circulating water constitute only two of the variables, tube life depends on the nature and/or extent of such other factors as:

Abrasives suspended in the coolant . . . Dissolved or entrained air or gases . . . Temperatures inside and outside of tubes . . . Chemical or electro-chemical actions . . . Marine growths or other deposits . . . Sewage and wastes present . . . Development of protective film . . . Media surrounding tubes.

One of the principal objects of Condenser Tube Technical Research has been the development of alloys designed to give the user longest tube life and most trouble-free service. Among the alloys developed to give a high degree of resistance to erosion-corrosion attack are Aluminum Brass and 70-30 Cupro–Nickel, each within its pertinent temperature limitations.

So many variables surround any condenser or heat exchanger tube application that each case must be treated as an individual problem.

Data accumulated during Scovill's continuous study of condenser and heat exchanger tube service conditions for every known application equip its Technical Service Department to offer sound guidance in tube alloy selection for existing or proposed installations.

THREE SCOVILL SERVICES

Scovill's *Service in Men* offers experienced engineering to help solve your tube selection and installation problems. *Service in Metals* develops and produces Scovill tube alloys that conform to your requirements. *Service in Manuals* consists of literature which gives you latest, authentic information on condenser and heat exchanger tubes. For a free copy of Condenser Tube Booklet, address Scovill Manufacturing Co., 13 Mill St., Waterbury 91, Conn. *Export Dept.* 405 Lexington Ave., New York 17, N. Y.

SCOVILL

SCOVILL

CONDENSER TUBES

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Service in Manuals . Service in Metals . Service in Men

Gives You

LONG, TROUBLE FREE SERVICE

Fig. 1635

"STANDCO"

PILLOW BLOCKS

The attractive "Standco" Pillow Block shown above is sturdily built and is offered in a wide range of sizes. Babbitted and broached bearing surfaces, accurately machined faces. Can be amply lubricated.

Write for Bulletin

"Unbrako" and "Hallowell" products are sold entirely through distributors.

Over 43 Years in Business

STANDARD PRESSED STEEL CO.

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IMO PUMPS

PERMIT DIRECT DRIVE AT ANY SPEED

The IMO pump can be connected directly to turbines, motors or other machinery without the use of reduction gears.

Operated at high speed, it is exceptionally small and compact in proportion to its capacity.

IMO pumps can be furnished for almost any capacity and pressure required for pumping oil, hydraulic control fluids and other liquids over a wide viscosity range.

For further information send for catalog I-138-P

IMO PUMP DIVISION
of the
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

President Truman has signed into law the first postwar Flood Control and River and Harbors Authorization Bills, which call for construction of projects totaling nearly $1,500,000,000. Only a relatively small amount of the work authorized by the bills, however, is expected to start this year under the program for holding down Government-construction expenditures. Separate appropriations must be enacted for projects authorized in the bills. Included in the flood-control measure is authorization of another $300,000,000 of work in the Missouri River basin, one half by the Army Engineers and one half to carry through the 1944 development program of Dept of Interior.

Cincinnati Gas Transportation Co. Charlestown, W. Va., has been authorized to construct about 70 mi of 14-in. natural-gas pipeline extending from a point in its main transmission line near Foster, Ky., to a proposed interconnection with Tennessee Gas & Transmission Co's 24-in. pipeline near Means, Ky., in a Federal Power Commission order made public recently. New line is authorized to increase deliveries of natural gas to meet requirements of Cincinnati Gas & Electric Co, which serves Cincinnati and other communities in southern Ohio, and Union Light, Heat & Power Co, which serves Covington, Newport and other northern Ky. communities. Cost is estimated to be $1,800,000. Completion of construction is expected by Nov 1.

Tennessee Gas & Transmission Co, Houston, Tex., has been authorized to construct facilities to increase by about 118,000 mcf per day the capacity of its some 1265-mi main pipeline system extending from near Driscoll, Tex., to Cornwell, W. Va., the Federal Power Commission disclosed recently. Cost is estimated at $27,405,717.

Hope Natural Gas Co, Clarksburg, W. Va., has been authorized to construct and operate major additions to its present transmission system in W. Va., according to a Federal Power Commission order. Estimated over-all capital cost of facilities is $5,327,500.

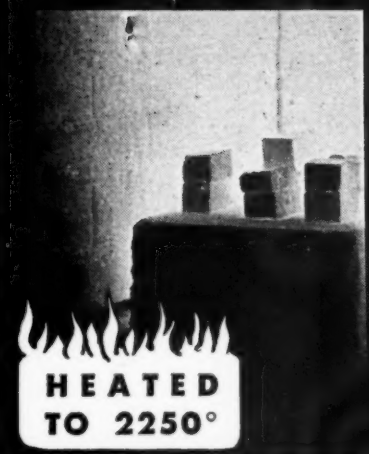
Georgia Power Co plans construction of a $4,000,000 steam-electric plant on the Flint River, 10 mi south of Albany. The 45,000-kw plant is expected to be completed in 1948. It will have capacity to add more than 1,000,000 kwhr a day to the state's electric supply. Albany plant will have two units, each containing a 22,500-kw turbine-generator and its individual boiler and accessory equipment. Generators, boilers and other machinery are on order.

Robins Conveyors, Inc, announced plans for immediate construction of a large manufacturing building when more than 1000 employes and guests met recently to celebrate the company's 50th anniversary. Other events on the outdoor anniversary program included tours through the plant, presentation of a historical memento to Thomas Robins, founder of the company, awarding of service pins to employes of many years, outline of expansion plans by President Thomas Robins Jr, etc.

Demonstrating

BRICKSEAL

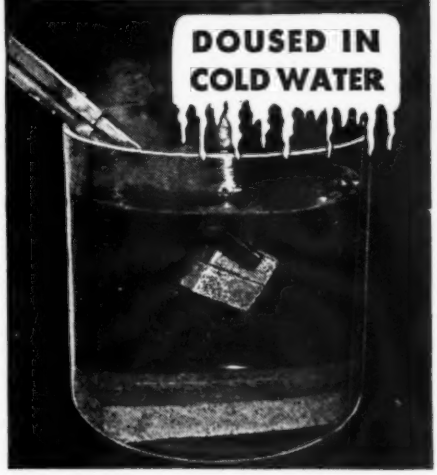
REFRACTORY COATING



HEATED TO 2250°

Brickseal provides a crackproof, vitrified armor for furnace linings. The small firebricks shown in the furnace were bonded and painted with Brickseal and heated to 2250°. Directly from the furnace they were plunged into cold water as shown below—a test for *any* material subject to expansion and contraction.

Brickseal is *semi-plastic when hot,* yet *hard and tough when cold.* Brickseal is made in grades suitable to heats ranging from 1400° to more than 3000°. It will make any furnace last longer by giving new life to your refractories. Write or call local dealer for a demonstration.



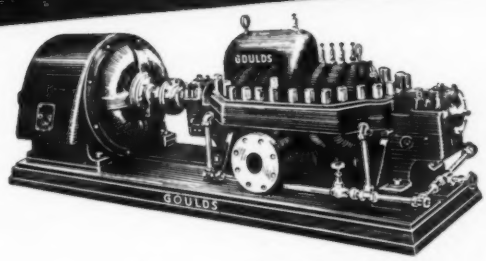
BRICKSEAL

REFRACTORY COMPANY

5800 S. Hoover St., Los Angeles, Cal.
1029 Clinton St., Hoboken, N. J.

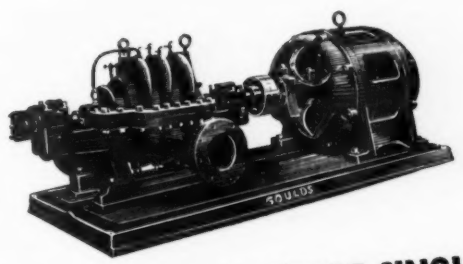
A QUICK GUIDE *to better pumping performance*

With these four Goulds Centrifugal Pumps, you could meet almost any liquid handling problem in the book. Goulds, of course, builds many other types for special services, but these four answer the majority of industry's pumping needs. Each type is made in many different sizes, thus enabling you to select the unit which gives you the highest efficiency for the job. May we help you with your next application?



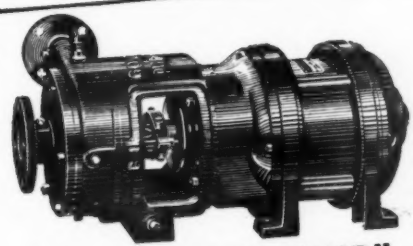
Goulds HIGH PRESSURE MULTI-STAGE *Centrifugals*

Featuring hydraulic balance, pumps of this type are used for high-pressure boiler feeding on a 24-hour basis. Goulds has a record for dependable performance under the most exacting conditions. They are sturdily constructed in sizes from 2" to 8" and in capacities ranging from 50 to 2250 G.P.M. with heads up to 3200 ft., depending upon capacity.



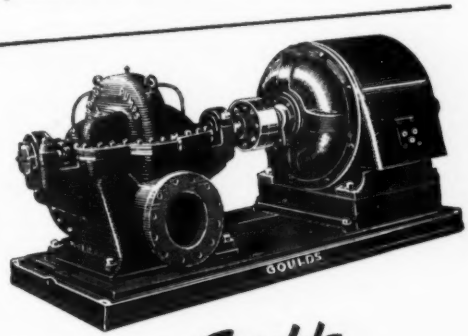
Goulds MULTI-STAGE SINGLE SUCTION *Centrifugals*

Designed for pressures up to 350 lbs., these pumps find wide application for general water service, boiler feeding, dewatering mines, humidifier service in textile mills, etc. They are available in two stages up to six stages with a capacity range of 100 to 1700 G.P.M. and heads up to 800 ft., depending on capacity.



Goulds "CLOSE-CUPLD" *Centrifugals*

These compact units can be installed in small spaces in any position for general service work. They are low in initial and operating costs and perform dependably on any service Goulds recommends. Available with *single* or *two stage* enclosed impellers, built in twenty sizes, handle from 5 to 1600 G.P.M. and heads up to 525 ft., depending on capacity.



Goulds DOUBLE SUCTION *Centrifugals*

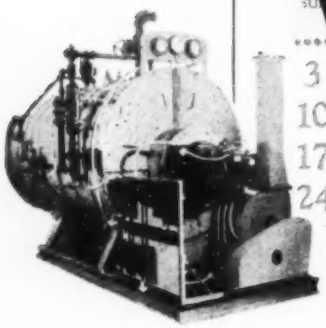
This is one of the most universally used pumps in the Goulds line. Its efficiency is excellent on water service, gasoline, oils, distillates, processing, condenser service, etc. They handle pumping requirements ranging from 100 to 14,500 G.P.M. with heads up to 475 ft., depending on capacity.

BULLETINS ON EACH TYPE AVAILABLE ON REQUEST.

Goulds PUMPS, INC.

SENECA FALLS, N.Y.

the PUMP FOR the JOB



1946 NOVEMBER 1946

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WHY it's time for a change to a...

PREFERRED UNIT STEAM GENERATOR

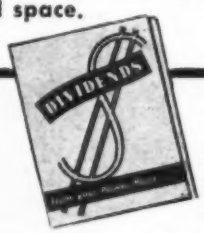
Most industrial boilers in use today are at least 15 years old. Their typical thermal efficiency is under 60%, which means excessive steam cost. Since steam is an important factor of production it is obvious that old, inefficient boilers must be replaced if a plant is to enjoy lower production costs and a stronger competitive position. The principal question, then, is—replaced with what?

For plants with steam requirements up to 500 hp, 200 psi, the oil-fired Preferred Unit Steam Generator answers the question with these advantages:

- **Guaranteed minimum thermal efficiency of 80%**
- **Pull-through draft—perfect combustion—no stacks**
- **New specially designed oil-burner which assures burning of new catalytic residual oils—fully automatic**
- **4-pass tube arrangement, further contributing to compactness and economy**

All this in one self-contained package of power. The Preferred Unit Steam Generator is a portable unit, shipped fully assembled ready to go to work. No special foundation required. Well adapted to limited space.

Send for complete information.



It's Easy To Get "Dividends From Your Power Plant"

Steam costs, as a part of production costs, are so closely related to profits that no plant can safely ignore any step leading to more economical steam generation. For many plants operating on a narrow margin, reduced steam costs may well be the difference between red ink and black. Therefore, as a service to steam users, we have published a 36-page booklet titled "Dividends From Your Power Plant" which discusses steam generation as a means of profit generation. In ten concise authoritative articles written by experts, it covers fundamentals and describes the most advanced methods for efficient, economical steam generation. The text is presented in clear, non-technical language and no advertising or sales talk is included. We believe you'll find this book a very practical guide to lower production costs. And it's easy to get "Dividends From Your Power Plant". Just use this coupon and it will come to you without charge or any obligation on your part.

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1860 Broadway, New York 23, N. Y.

See our Exhibit at New York Power Show December 2-7. Booths 30 and 31

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P-11-46

Preferred Utilities Mfg. Corp.,
1860 Broadway, New York 23, N. Y.

Please send me Bulletin 1000 describing Preferred Unit Steam Generator. Also the booklet of vital facts for executives — DIVIDENDS FROM YOUR POWER PLANT.

Name.....

Address.....

.....

PREFERRED UTILITIES

British Columbia government has given official approval to proposals of British Columbia Electric Railway Co to develop the initial unit of its Bridge River power scheme. The government's order lists following projects: Installation of one 62,000-hp hydroelectric generating plant; construction of first portion of a powerhouse with settings for three machines; construction of a diversion dam at site No. 7, just below the present tunnel intake; miscellaneous work at Seaton Lake end of the tunnel: construction of a penstock from tunnel to powerhouse site; necessary low-voltage switching equipment with auxiliary equipment and transformer capacity to step up the voltage for transmission to Vancouver: one transmission line to be carried on steel towers from Bridge River to Vancouver.

Willis Rodney Whitney, organizer of General Electric research laboratory, received the first **Industrial Research Medal** at a dinner, Oct 17, stated Dr Chas S Venable, president of the Institute.

General Electric Co expects reduced costs and a consequent broadening of uses for silicone products with production in its new Pittsfield, Mass., silicone plant, stated Harry K Collins, manager of resin and insulation materials div.

J H Watters, president, **Union Asbestos & Rubber Co,** announced an increase in the capacity of its Blue Island plant when expansion program now under way is completed.

Ric-Wil Company opened its Barberton, O., plant to an inspection tour for delegates to the recently held National Association of Power Engineers convention in Cleveland. Specially constructed machines exhibited operation and workmanship in factory assembly of complete overhead and underground distribution piping systems.

E G Kominek, **Infilco, Inc.,** discussed diatomite filters at the American Chemical Society fall meeting. These filters provide positive removal of organisms such as amoebic cysts, chironomus or blood-warm larvae, not ordinarily touched by chlorine or removed completely by sand filters, claimed Kominek. He further claimed filtration rates of eight gpm per sq ft. application advantages for adsorption of oil from condensate, and reduction of tastes and odors from water.

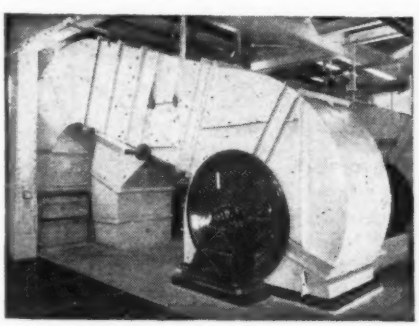
U. S. Rubber Co purchased a new plant at Ft. Wayne, Ind., from the Government, and plans to triple production of its high-speed grinding wheels, announced J A Fairfield, manager of grinding-wheel sales.

Monsanto Chemical Co acquired at $9,550,000 a Government-owned syrene plant at Texas City, Texas, from the War Assets Administration. This plant was built and operated for the Government.

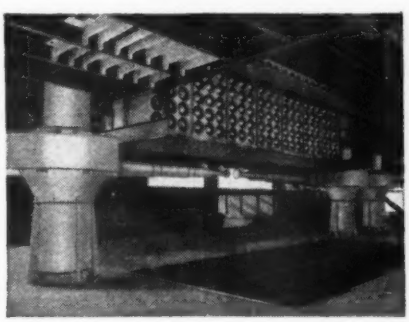
Sterling Engine Co, Buffalo, N. Y. received an order of about $1,500,000 in addition to a $1,000,000 previous one for diesel engines to be supplied to the Whitcomb Locomotive Co.

You, too, can crack the whip on THREE AT A TIME!

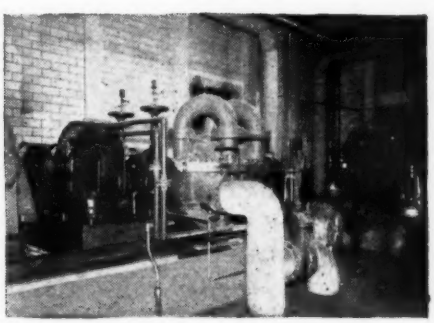
One source for technical information—undivided responsibility—less red tape when you buy all three from ABC! That's the way you can crack the whip on your problems on Mechanical Draft Fans, Fly Ash Precipitators, Variable Speed Control.



1 **Mechanical Draft Fans** of high operating efficiency and long life are standard with American Blower. Since 1881 we have built fans for many of the leading public utilities and a wide range of industrial applications.



2 **Fly Ash Precipitators** of simple, but effective design have resulted from our long association with power plants and power plant equipment. American Blower Precipitators have no moving parts, occupy minimum space.



3 **Gyrol Fluid Drive** was pioneered and introduced to industry by American Blower. Here is the answer to stepless variable speed control for both mechanical draft and boiler feed pump drive—a big help to overall power plant efficiency, too!

At your request, the nearest American Blower Branch Office will make a complete presentation with technical data and prices. Phone or write today.

Buy all 3 from ABC

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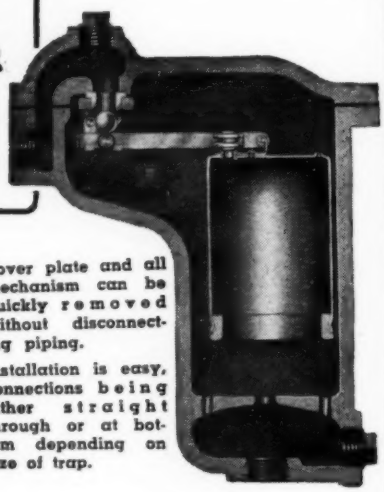
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

10 GOOD REASONS WHY BUYERS PREFER "CRYERS"

....all's well with

CRYER TRAPS



1. Sediment chamber can be cleaned by removing clean-out plug and flushing.
2. Baffle plate prevents slugs of condensate from raising bucket prematurely and thereby provides a cushion action.
3. Stainless steel mechanical quick-venting valve allows rapid discharge of air without regard to temperature.
4. Bucket is strongly made of hard drawn brass.
5. Stainless steel seat can be removed even after long service by merely pressing thumb. There are no threads on seat.
6. Bronze fulcrum which holds seat in position can be easily removed.
7. Free turning hard stainless steel rolling ball insures correct seating at all times.
8. Bronze test plug easily removed so that operation can be watched without disconnecting piping.
9. Cover plate and all mechanism can be quickly removed without disconnecting piping.
10. Installation is easy, connections being either straight through or at bottom depending on size of trap.

Capacities from 500 to 38,000 lbs. water; pressures from 0 to 250 lbs.; sizes ½" to 2½" inclusive.

Also

Thermostatic Radiator Traps; traps and spare parts for the line formerly known as J-M Ball Steam Traps.

Full details on request.

CRYER TRAP & VALVE CO., INC.

366 MADISON AVE. NEW YORK 17, N. Y.

Manufacturers of steam specialties for more than 40 years.

It's Easy

TO STORE MORE COAL NOW WITH A

SAUERMAN SCRAPER SYSTEM

IT WILL PAY YOU to investigate Sauerman Power Drag Scraper Systems for storing and reclaiming coal.

You can save labor for these systems move coal to and from any point in the storage area under virtual "push-button" control of a single operator.

You can save space for a Sauerman machine stores maximum tonnage on any available area.

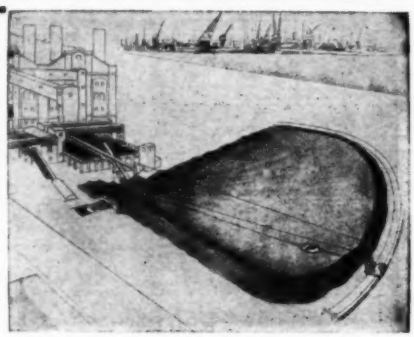
You can avoid unnecessary hazards for a Sauerman machine builds a pile that is homogeneous, compact and safe.

You can save money for users' records show average maintenance costs of less than a cent per ton of coal handled. Installation cost is surprisingly small.

Send for Catalog.

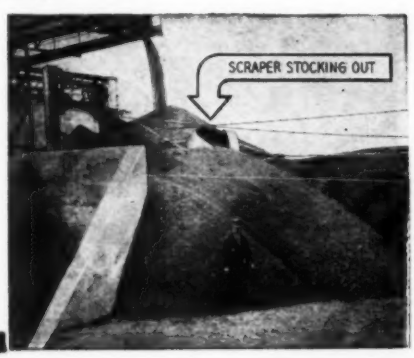
SAUERMAN BROS., *Inc.*

562 Clinton St., Chicago 7, Ill.



The municipal steam-electric generating plant of Belfast, Ireland, burns about 200,000 tons a year, all water-borne. A dock crane transfers coal from ships to conveyor system which first fills the plant bunkers, then delivers remainder of cargoes to a 2 cu. yd. Sauerman Scraper System installed on adjacent dock. Scraper, operating on a 360 ft. radius spreads coal over fan-shaped storage area, building compact pile to height of 20 ft. or more and reclaims from this pile.

Sketch shows stockpile and scraper system with scraper reclaiming. Photo shows scraper receiving coal from conveyor.



Company Purchases New X-Ray Machine

Babcock & Wilcox Co has announced the purchase of a 2,000,000-volt X-ray machine to be installed in a special building at their Barberton, Ohio, plant. Total cost will be $150,000.

This machine, together with a 1,000,000-volt unit already in operation, brings the total of X-ray machines to twelve at this plant. The new unit operates at any voltage from 1,000,000 to 2,000,000 volts. Plans call for its use on welds, 4 in. and over, and, at the 2,000,000-volt setting, to reduce radiograph time and give better pictures. It can penetrate steel walls up to 10-in. thickness.

To prevent radiation, a specially designed building, 35x31x81 ft, with double walls of 42-in. thickness, composed of sand packed solid between ¼-in. steel plates, will house the machine. An overhead crane will support and move the 6000-lb X-ray machine, which is 5 ft in dia, 12 ft, 6 in. long. The building will handle boiler drums up to 75-ft length and 13-ft dia.

General Electric Co recently announced that mirror-bright fine-contoured welds for alumiuum result from a brief degreasing in a 5% solution of sodium hydroxide to remove all grease, oil or wax, and a brief wash in water for removal of scum and caustic. Following degreasing, the aluminum is dipped into a 50% sulphuric acid bath to complete removal of the oxide skin. This acid is then taken off in a hot-water bath, and the clean, dry metal is ready for welding.

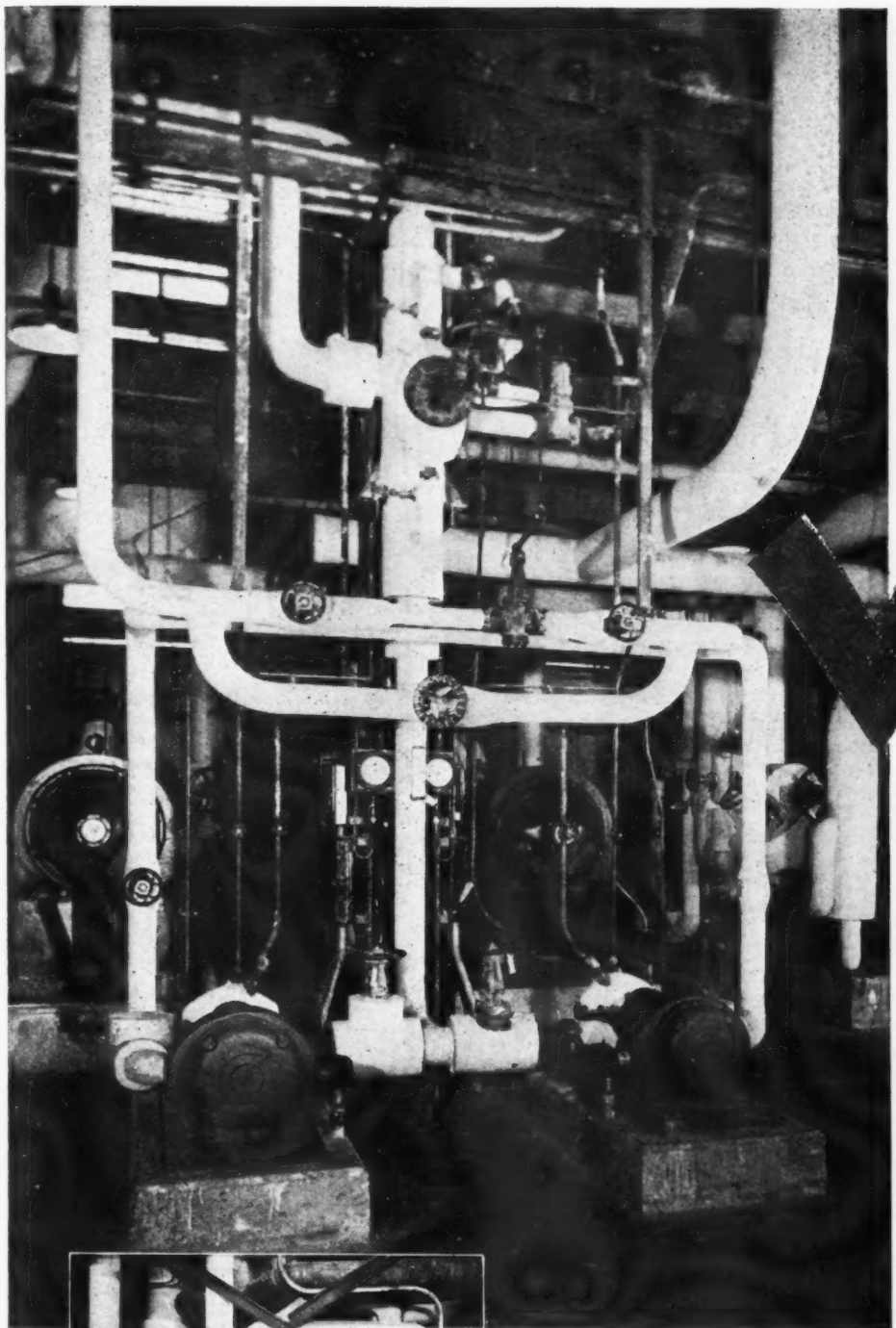
McGraw-Hill Book Co announces a 1946 catalogue of books in which appears the date by year of publication or last revision.

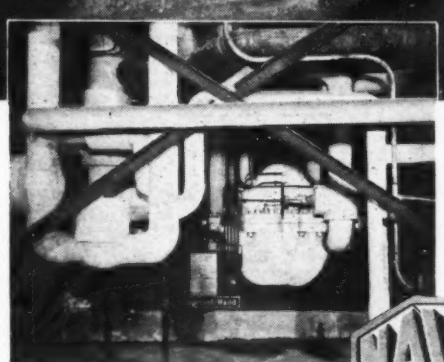
General Electric Co announced near-completion of the last of three 90,000-kva hydroelectric generators for Russia's Dneiper Dam. Units, 42 ft, 5 in. dia, weigh 2,250,000 lb and are said to be the largest ever built.

Harold Von Thaden, first vice-president, **Robins Conveyors Inc,** subsidiary of Hewitt-Robins Inc, left for Johannesburg, South Africa, to analyze and study market conditions and distribution in that country.

Murray Iron Works has received a $113,750 contract from the Chillicothe, Mo., Board of Public Works. This contract covers a 65,000-lb-per-hr steam generator. Detroit Stoker Co will furnish a spreader stoker and an ash hopper, while Republic Flow Meter Co will supply combustion controls and instruments.

Sullivan Hoist Div. of Joy Mfg Co received a Naval citation for Naval Ordnance development during the war. Special individual recognition was accorded R C Osgood, chief engineer and manager, J A Drain, vice-president in charge of engineering and the late Alton Hilliard, former assistant to R C Osgood.





NAVCO PIPING INSTALLATIONS ARE THOROUGH

The measure of any piping system, after the proper design has been reached, is the "fit". The knowledge which we have gained in the past 40 years is your guarantee of an accurate and workmanlike piping system. Navco quality in workmanship and design is evidenced by the many successfully operating installations which we have made for every industry. Consult Navco for your next piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

HERCULES
SEAMLESS COPPER
FLOATS
HERCULES

GUARANTEED
TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

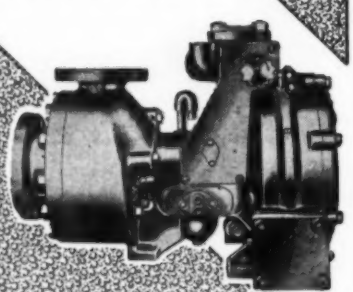
You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure carefree maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

COFFIN TURBO PUMPS

FOR BOILER FEED AND GENERAL HIGH PRESSURE SERVICE



THE J. S. COFFIN, JR., CO.
ENGLEWOOD, NEW JERSEY

APPOINTMENTS

Perfex Corp announces the following promotions (1) E J Galdabini from manager of factory sales to purchasing agent (2) A G Kornitz from assistant manager of factory sales to manager (3) E W Weise to assistant manager, factory sales (4) Walter Quade to assistant purchasing agent.

E C Brown, service engineer, **Richardson Scale Co,** has replaced Benjamin K Hough who has retired, as New England sales representative. Hough will, however, continue as New England sales representative for **Merrick Scale Mfg Co.**

Stuart D Distelhorst, **Cochrane Corp,** sales promotion manager, recently returned from service in the Army and has resumed his duties. Joseph S Oldknow, personnel manager, assumed direction of sales promotion department during Distelhorst's absence and will retain layout and production of advertising and printed matter.

Goodyear Tire & Rubber Co's Lecheria, Mexico, plant will have as its plant engineer, Harry A Walker, according to an announcement by George K Hinshaw, company's production manager of foreign operations.

Curtis H Stout, formerly with Westinghouse Electric Corp and the Southwest Sales & Service Co, will represent **Stearns Magnetic Mfg Co** in Arkansas; Frank Brunner, former assistant superintendent at the company's main plant becomes superintendent of the brake factory and Herbert L Piasecki is office manager at Milwaukee.

Pennsylvania Flexible Metallic Tubing Co, Philadelphia, announces that piping layout design is a new service now available from its engineering dept.

Martin Toscan Bennett, consulting engineer, announces the opening of an office in Washington, D. C., to practice general industrial engineering with special facilities for foreign developments.

Westinghouse Electric Corp appointed A W Larson, lighting engineer, to the post of manager of lighting and distribution apparatus, agency and specialties sales dept. Walter H. Kelly, manager, industrial development dept, West Penn Power Co, becomes Pennsylvania state vice-chairman of the **Committee for Economic Development,** announced Walter Fuller, president of Curtis Publishing Co, and chairman of CED.

ASME 1947 officers recently announced are: Eugene W O'Brien, publisher of Atlanta, Ga., president; the following as regional vice-presidents, Linn Helander, professor, Manhattan, Kans.; Thomas S McEwan, vice-president of McClure, Hadden and Ortman, Chicago; Albert R Mumford, development engineer, Combustion Engineering Co, New York; Edward E Williams, general superintendent, steam plants, Duke Power Co, Charlotte, N. C.; Alton C Chick, assistant vice-president, Manufacturer's Mutual Fire Insurance Co,

Are You Satisfied

That your boilers and engines are operating efficiently? Naturally, they can not, if scale and corrosion interfere.

SAND-BANUM

"The Entirely Different Boiler and Engine Treatment"

Can help you, for its function is to automatically remove and prevent scale and corrosion, while your equipment operates. Thus you gain clean heat transfer surfaces, which mean more power, less fuel and fewer shut-downs.

You Can Try

this proved and patented product with a meritorious service record for more than 20 years on a

Better Than Money Back Guarantee

Unconditional Guarantee

Try it entirely at our risk for 30, 60 or 90 days. It must perform to your entire satisfaction or you owe us nothing. No money in advance; not even shipping charges.

SEND For Sample Today

★

This proved product is a pure colloidal compound, guaranteed absolutely harmless to personnel and equipment.

★

AMERICAN SAND-BANUM COMPANY, Inc.

9 Rockefeller Plaza, New York 20, N. Y.

Stocks carried by
WESTERN SAND-BANUM COMPANY
Houston, Texas

and at other convenient points including leading supply houses

Export Representatives
PETROLEUM MACHINERY CORP.
30 Rockefeller Plaza New York 20, N. Y.

Here's what the chief engineer of a large sugar refinery—using its own generators and over a thousand motors from ¼ to 150 HP—has to say about "Megger" Insulation Testers:

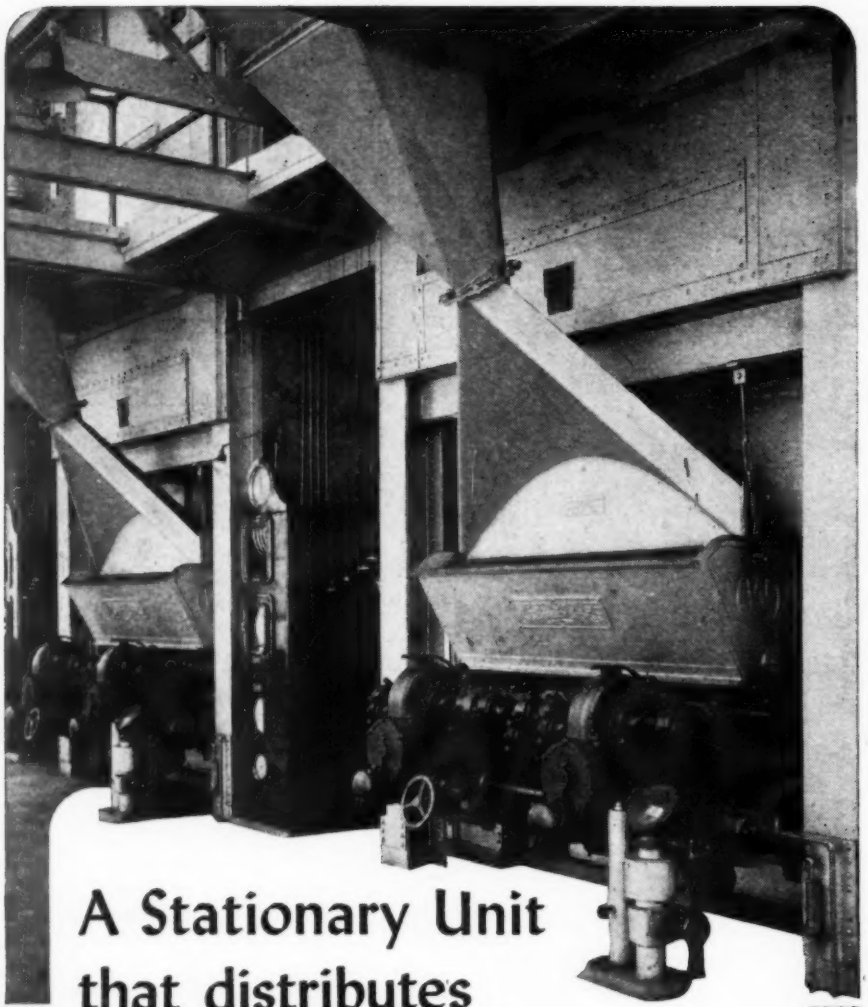
"Every Saturday . . . the Wizard (Chief Electrician) applies our 'Megger' Tester to all of our important generating equipment. Usually nothing happens. . . . Then one day the 'Megger' test indicates a leak. . . . Like the surgeon's X-ray the 'Megger' test detects the condition, and a failure is forestalled. With our insulation resistance records we further watch any progressive weakening of the 'arteries' and have warning that permits us to make repairs at convenient times. . . . A maintenance gang without a 'Megger' tester would be like a surgeon without an X-ray machine."

Are you getting the benefit of this kind of insurance protection for the important electrical equipment in your plant? "Megger" Insulation Testers are available in various types (including the unique "Bridge-Meg" instrument here illustrated) with ratings up to 10,000 megohms and 2500 volts d-c. Write today for descriptive, illustrated Catalog 1685-P.

The photograph and the quotation in this advertisement are used by courtesy of the Pennsylvania Sugar Company of Philadelphia, and Dan Gutleben, who until recently was Chief Electrical Engineer.

James G. **BIDDLE CO.**
ELECTRICAL & SCIENTIFIC INSTRUMENTS
1316 ARCH STREET • PHILADELPHIA 7, PENNA.

"MEGGER"* INSULATION RESISTANCE TESTERS



A Stationary Unit that distributes coal without segregation?

Yes . . . it's the CONICAL Non-Segregating Coal Distributor! To see how it works make the simple test illustrated here. Cut two pieces of note paper in the shapes shown in Fig. 1 and 2—the square piece to represent a flat coal chute—and the pie-shaped piece, the CONICAL Distributor. Holding the square slip tilted sharply, roll a cigarette between your fingers, sifting tobacco onto the inclined surface. Notice how the tobacco slides down the center of the sheet and forms a pile, over which the large particles may roll and through which the fine particles may sift.

Now hold the pie-shaped slip so as to form a cone segment and repeat the sifting operation. Watch the large and small particles begin distributing themselves early in their fall and note that both large and small particles land uniformly spaced and evenly distributed at the base of the cone. This kind of distribution means better firing and lower stoker and arch maintenance; and you *get* that kind of distribution with CONICAL Distributors! For more information write Stock Engineering Co., 715 Hanna Bldg., Cleveland 15, Ohio.

1 2

1A 2A

STOCK ENGINEERING CO.

★

CONICAL
Non-Segregating
Coal Distributors

★

S.E.CO.
Coal Valves and Coal Scales

Providence, R. I. Directors at large are Frederic S Blackall, Jr, Woonsocket, R. I.; Wilber A. Carter, Detroit, Mich.; Lewis F Moody, Princeton, N. J., and another director at large to be appointed later.

Parker Appliance Co reelected Mrs H M Parker, H R Boyer, C W Johnson, H I Markham, C C Sigmier, S B Taylor and J A Weeks directors; with H I Markham, chairman of the board; S B Taylor, president; C H Wagner, Jr, vice-president and secretary; R W Cornell, treasurer and comptroller.

C E Prudden, consulting engineer, Allis-Chalmers Mfg Co, tractor div, becomes sole nominee for 1947 presidency of the **Society of Automotive Engineers,** it has been announced.

Baker Ice Machinery Co announced through its president, Ross Rathbun, the following appointments: (1) Charles Knox from chief engineer to plant manager, (2) A L Atherton, former Westinghouse engineer, to manager of manufacturing, (3) John H Stewart from assistant production manager to purchasing agent.

Pierce Renewable Fuses, Inc, elected Wm Brennan, chairman of the board; Louis R Popp, president and general manager; Arthur M Popp, vice-president and general works manager; M D Popp, secretary and treasurer; D O Granger, general sales manager.

Timken Roller Bearing Co, steel and tube div, announced these appointments: H R McLaven, formerly superintendent of tube mills, to assistant general superintendent; J P Wargo, assistant superintendent tube mills and finishing dept to superintendent of tube mills; R R Elsasser, manager of Newton Falls, Ohio, plant, to assistant superintendent of tube mills.

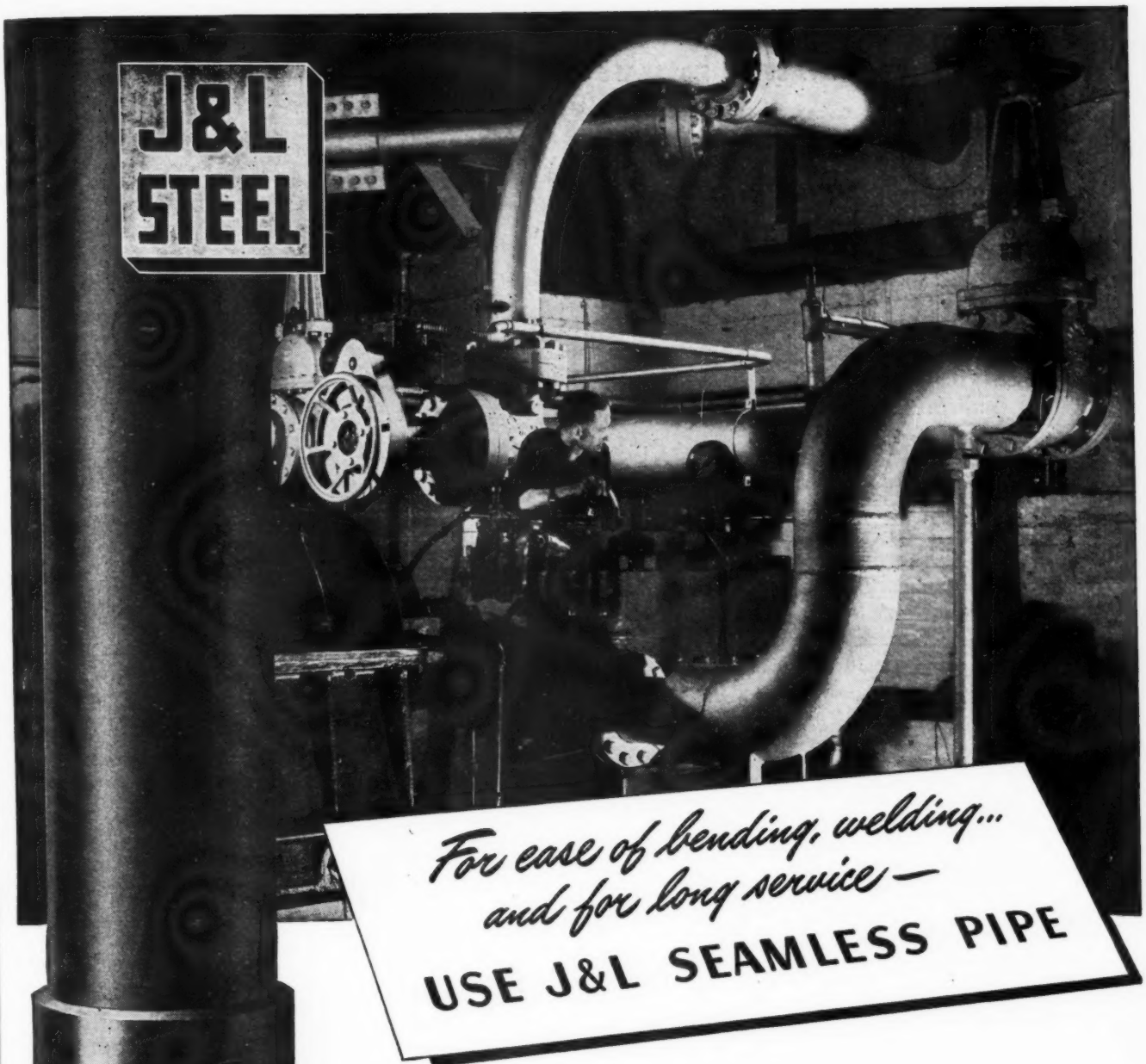
R B Werey, president, **Conoflow Corp,** appointed Donald P Eckman technical consultant on industrial-control devices.

Bryant Heater Co appointed Homer A Size, California representative, and Arthur X Nelson, Minneapolis representative, for the industrial div in application of gas-combustion elements to industrial- and process-heating equipment.

J L Singleton, district offices manager, **Allis-Chalmers Mfg Co,** announced the following appointments: J R Reed, general manager, commercial research dept; J F Fitzsimmons, supervisor in charge of research; Anson J Bennett, Jr, supervisor, sales analysis.

Byron Jackson Co acquired the Butte Pump & Motor Works, Chico, Calif., it has been announced, with A F Vonnegut as manager.

R G LeTourneau, Inc announces that Wendell Richards, district sales representative, has been promoted to market research manager, Cloyd Richards, assistant service manager, to general service man-



For ease of bending, welding... and for long service—

USE J&L SEAMLESS PIPE

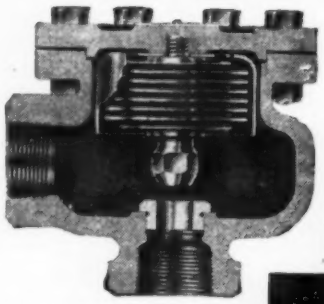
J&L steel pipe is made of J&L Controlled Quality steel especially for bending and welding in power plant installations. The long experience and skill of J&L men enables you to obtain a pipe that has uniform wall thickness, is clean and straight for your most exacting installations. J&L steel pipe is made to give long and satisfactory service. Write for information.

JONES & LAUGHLIN STEEL CORPORATION

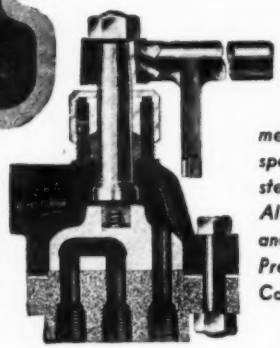
PITTSBURGH 30, PENNSYLVANIA

NICHOLSON VALVES AND TRAPS FEATURE

SIMPLICITY THAT MAINTENANCE MEN ADMIRE



THERMOSTATIC TRAPS—2 to 6 times greater valve area. Five industrial types: size 1/4" to 2"; pressures to 225 lbs. Bulletin 544.



CYLINDER CONTROL VALVES—Two, three, four-way, multi-port, metering, distributing and special types. For air, steam, oil, gas, tar or water. Also lever, foot, solenoid and motor-operated types. Pressures to 5000 lbs. Catalog 546.

SEND FOR CATALOG OR

SEE OUR CATALOG IN SWEET'S

Here are two initial reasons why Nicholson valves and traps "win friends and influence people" in maintenance departments: their simplicity of design results in maximum freedom from trouble; their ruggedness withstands unavoidable abuse. For additional features let us send you catalogs.

W. H. NICHOLSON & CO. 125 OREGON ST. WILKES - BARRE, PA.

"Real control of blow-off"

SAYS USER

"We have been using the Multometer Continuous Blow-off on our Boilers for the past seven years and are very well satisfied with the results. There is no service or replacement required and they enable us to hold boiler concentration just where we want it. We test our Boiler Water every day and when we open the Boilers they are clean and free of scale. Another thing we like about it is that priming and 'carry over' are completely eliminated."

MULTOMETER SYSTEM

Continuous Boiler Blow-off

• The MULTOMETER represents the sure method of measured flow control and because of its design will not wire draw, cut out, or wear out. It is adapted for use with every kind and size of boiler and every character of feed water.

Write today—one of our engineers will be glad to confer with you.

P. E. MADDEN & CO.

352 W. Walton St. Chicago, 10, Ill.

ager; O A Williams, district sales representative, to eastern sales manager, C F Zimmerman, general service manager, to district sales representative; Harold R McQuarrie, eastern credit manager, to assistant domestic sales manager.

H H Van Atten has been appointed district sales representative for **Skinner Engine Co** in Cincinnati.

Appointment of Dr C K Bump and H W Mohrman as assistant director of research was announced by Dr N N T Samaras, research director, plastics div, **Monsanto Chemical Co.**

Anaconda Wire & Cable Co announced that C H Porter, eastern sales manager, has been made manager of industrial, wholesaler and contractor sales, and J W Mullally, manager of bare and weatherproof sales, has been made utility sales manager.

Fluid Controls Co will represent Kieley and Mueller, Inc in the Philadelphia area.

Clyde O DeLong succeeds Fred A Lang, now general manager, shoe product sales div, as manager of industrial products sales div of **B F Goodrich Co,** announced E F Tomlinson, division general manager.

G L Furr, div manager, **Appalachian Electric Power Co,** becomes assistant general manager and his assistant, J P Gills, takes over his post, announced M C Furk, vice-president and general manager.

Albert McKahn, president, Acme Rubber & Mfg Co and Hamilton Rubber Mfg Co, announced the merger of these two companies to form **Acme-Hamilton Mfg Corp** with offices at Trenton, N. J.

M W Dunton Co is now being represented in Chicago by Jack Kasrel.

Richard F Muller succeeds F W Stevens as manager, New Orleans office, **Allis-Chalmers Mfg Co.**

W B Pierce will manage the consolidated sales development and engineering service div of the **Allegheny Ludlum Steel Corp.**

Snap-On-Tools Corp announced through its president Joseph Johnson, the promotion of William R Elwell to merchandising dept buyer from sales engineer.

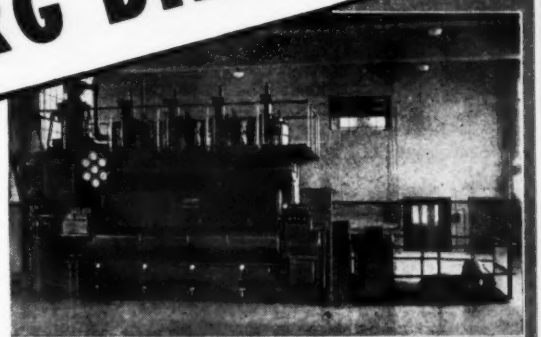
Ampco Metal, Inc announces the election of J Donald Zaiser as president and general manager to succeed his father C J Zaiser, who died July 29.

American Engineering Co will be represented by Schall Co in Buffalo, N. Y. and W K Sowden Co in New York. H M Lodge, formerly with American Engineering Co, is now with Sowden and will handle New York State territory.

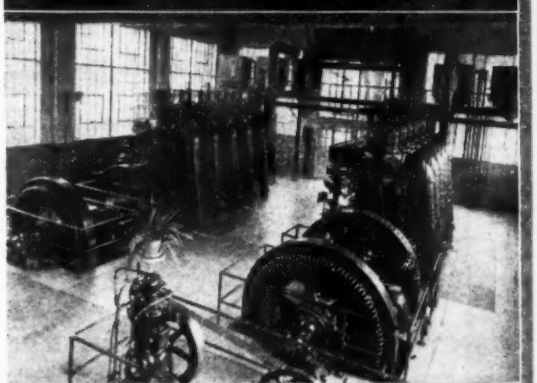
Permutit Co announces through its president, H W Foulds, the acquisition of Simplex Valve and Meter Co. John C

1620 H. P. IN 1946

The 4th. NORDBERG DIESEL for Neodesha



880 H. P. IN 1934



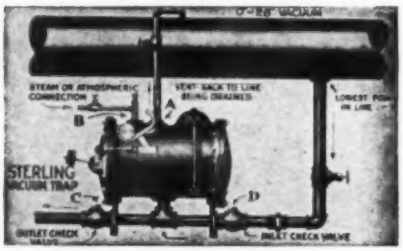
Two 550 H. P. IN 1922

● The City of Neodesha, Kansas is another in the long list of users of Nordberg Diesels that have placed repeat orders with us because of the satisfactory performance of earlier installations. In 20 years of operation, Neodesha has had but one service interruption due to the engines, and this only for 10 minutes. This is all the more remarkable when it is remembered that the two original engines are still in service after 24 years and regularly carry their share of the load. For dependable, economical power, join with the many satisfied users of Nordberg power and make that next unit a Nordberg Diesel.

NORDBERG MFG. CO., MILWAUKEE 7, WIS.

NORDBERG
DIESEL ENGINES

TURBINE USERS!



STERLING vacuum Traps Will Drain Condensate From Lines Or TURBINES Under Any Stage of Vacuum, When Installed Below Lines or Turbines to Be Drained.

Operated by Either Low Pressure Steam or Atmosphere Depending on Type of Service Desired. Let us know your problem.

Sterling Engineering & Mfg. Corp.
(Templeton Mfg. Co.)
110 Business St.,
Hyde Park, 36, Massachusetts

COMING IN
DECEMBER POWER

A 48-page special section on Boilers and Steam Generators

— covering fundamentals, boiler types, construction, design, performance, selection, operation and maintenance. To make certain you receive this important operation and maintenance aid, subscribe now to:

POWER
330 West 42nd St.
New York 18, N. Y.

Tracey has been named sales representative for Permutit in Washington, D. C. H J Harp, former treasurer National Assn of Power Engineers, is Permutit representative in the Philadelphia office.

Ralph T Brengle has been placed in charge of the **Montgomery Mfg Co** national sales office, Chicago, Ill.

Fayette Leister, engineering manager, **Fafnir Bearing Co,** has been elected by the board of directors, vice-president in charge of engineering.

A B Gibson, president, **Gibson Electric Co,** announces appointment of Herbert C Graves, Jr, chief engineer.

J L Trudinger, plant engineer of the River Works, **General Electric Co,** Lynn, Mass. retired after 30 years with the company.

International Nickel Co, Inc announced that J E Fifield, formerly with U. S. Naval Research, has joined the New England technical section of the company's development and research div, and E A Tice has joined the corrosion engineering section of this div in New York.

H R Iverson will be in charge of the Washington, D. C., office of **Carlo Coil Co.**

J M Hopwood, president, **Hagan Corp,** organized a dinner in tribute to T A Peebles, retiring vice-president in charge of engineering. Eighty fellow workers and friends attended.

Wickwire Spencer Steel moved its general sales manager's office from New York City to Buffalo, N. Y. Percy Jenkins, sales manager of hardware products, will also serve as sales manager of the newly created Eastern district.

P M Dinkins has been made president and a director of **Jefferson Chemical Co, Inc,** a company organized in 1944 by American Cyanamid Co and the Texas Co.

J M G Fullman, general design engineer, **National Electric Products Corp,** has retired after 33 years with the company. Walter L Rubel, formerly captain USNR, has joined the firm of **Guy B Panero,** successor to Clyde R Place, consulting engineers, as an associate in charge of industrial and power div.

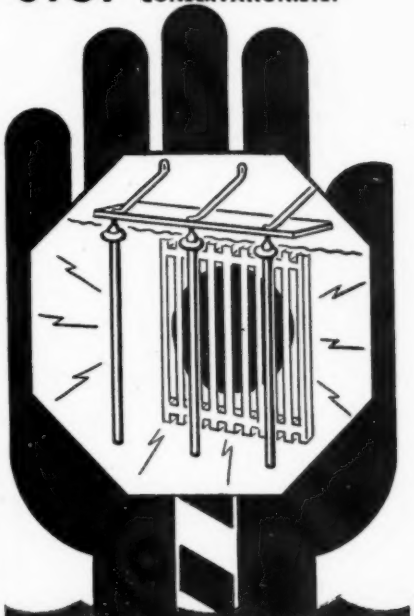
Noma Electric Co announces the election of the following directors, Dr Boris Emmet, David F Kahn, Leo L Pollak and Carl Schlesinger.

Thermoid Co announces appointment of Max F Zullig as chief of chemical section, research dept.

Oscar D Hickley, **Ohio State University,** advanced from associate to full professorship in the industrial engineering dept.

Lovejoy Flexible Coupling Co announces appointment of Walter B Briggs, former manager, power transmission div, Ideal Industries, Inc, to general manager

STOP NEEDLESS DESTRUCTION OF FISH!
STOP HEAD LOSS . . . AT YOUR INTAKES!
STOP SCREEN MAINTENANCE WORRIES!
STOP CRITICISM . . . FROM CONSERVATIONISTS!



AN INVISIBLE BARRIER

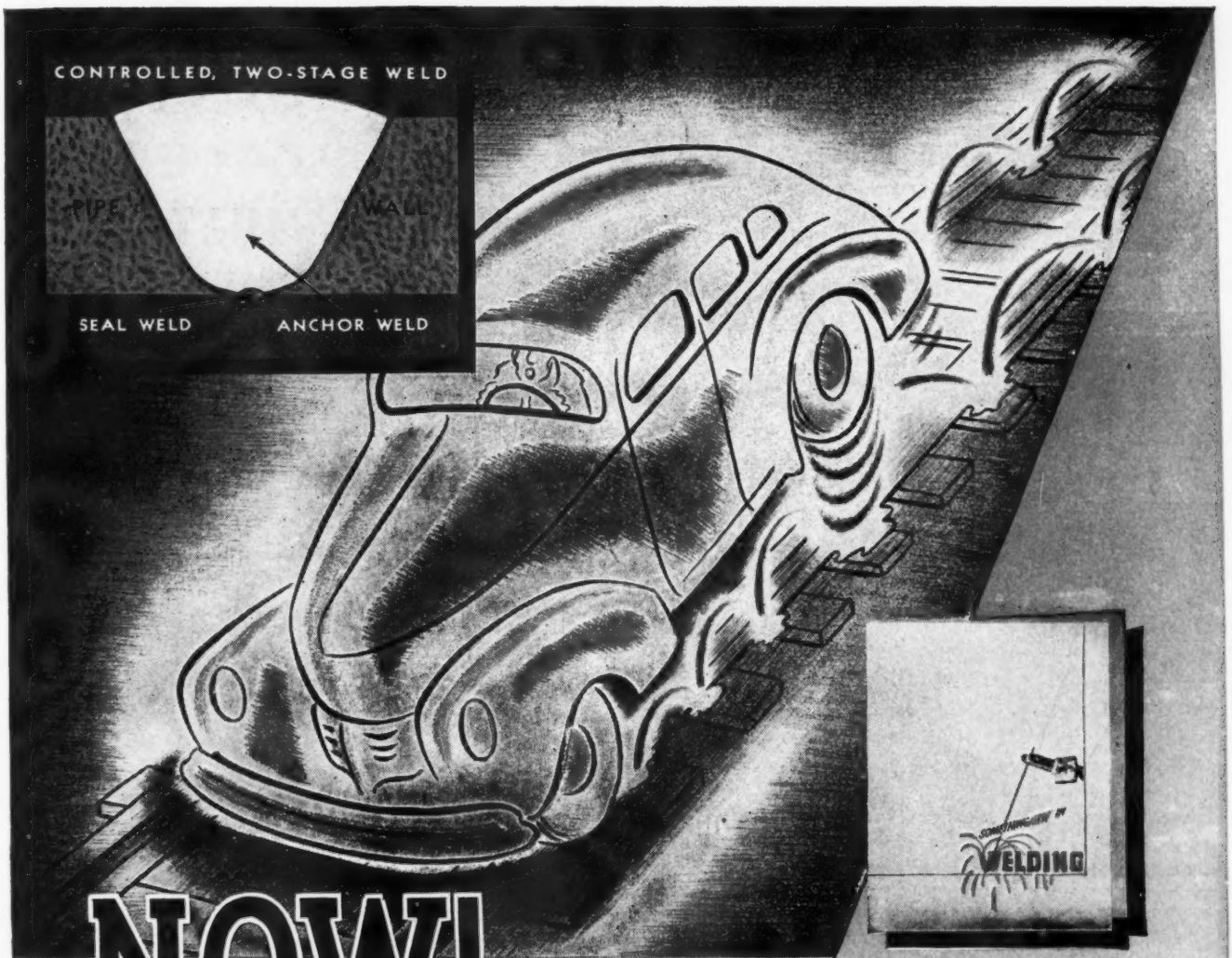
YOUR ZONE of PROTECTION

Burkey Electric Fish Screens solve your fish control problems—cheaply, effectively, harmlessly. Electronic impulses keep fish of all sizes *safely* away from intakes or outlets. The electrode systems are custom-built for your particular intake—designed to permit a full head of water. No screen cleaning necessary.

Every Burkey installation is engineered to your problem regardless of size. Burkey Electric Fish Screens are thoroughly proven by years of service in condensing water intakes, hydroelectric plants, water systems and industrial pumping installations. Recommended by State Conservation Officials.

★ SEND FOR LITERATURE AND QUOTATIONS

ELECTRIC FISH SCREEN CO.
1130 N. Poinsettia Place • Hollywood 46, Calif



NOW! NOTHING LIKE THIS INSIDE OF BUTT WELDED JOINTS*

Exaggerated, yes; we're merely trying to emphasize the effect of backing rings on flow in butt welded pipelines. And if the ends of the pipe lengths are recessed to lessen these "humps," pipe strength is sacrificed. And if no rings are used, protrusions of weld metal produce the same "humps" again, but they are rough-jagged, except where the patented Westport Method of Controlled, Two Stage Welding is used. This produces a pipe contour, smoother on the inside than on the outside, with maximum bondage and strength. . . . Our bulletin "Something New in Welding" tells the complete story. Write for it today. And remember, while our shop pre-fabricated piping can be made with any type of joint, we believe you'll prefer and specify the Westport, after you read our bulletin.

WESTPORT JOINT

*MADE WITHOUT BACKING RINGS BY THE MITCHELL-WESTPORT METHOD

(PATENTED)

W. K. MITCHELL & CO., INC.
2944 ELLSWORTH STREET
PHILADELPHIA 46, PA.
SINCE 1899

MITCHELL

PIPING FABRICATORS AND CONTRACTORS

SCHERR

PRECISION INSTRUMENTS

For Close Reading

HAND TACHOMETERS

Measure rpm without timing or calculation while held against end of rotating shaft. Any variation in speed caused by belt slipping, overload, etc., is instantly noted. Also have disc for measuring surface speeds in feet per min. Made for speeds from 30 to 12000 changing speed range by new rotating shift mechanism. Other types to 48,000 rpm. Write for details.

SPEED INDICATORS

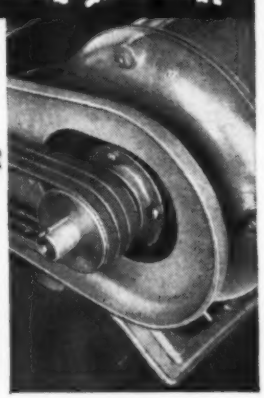
Gives direct readings in rpm in a test requiring only 6 seconds. Needle remains at reading until released by pressure of button. Also measures linear speeds using disc attachment. Two types, ranges to 20,000 rpm. Full data on this and other Scherr speed measuring instruments on request.

GEO. SCHERR CO., Inc.
196-A Lafayette St.
New York 12, N. Y.

Lubricate with... LUBRI-TASGON

FOR TOP *Efficiency*

FOR LONGER LIFE



Here's the result of an extensive laboratory test in which Lubri-Tasgon was tested against other high quality lubricating oils. Lubri-Tasgon proved to have 20% to 30% more lubricating power than the next most efficient oil tested.

1. Lubri-Tasgon's principle of colloidal penetration draws it into the tightest joints and bearings.
2. The "wetter" in Lubri-Tasgon spreads the lubricant and flushes off rust, carbon, grit, etc.
3. An anti-oxidant in Lubri-Tasgon slows up oxidation and prolongs the working life of the lubricant.

See For Yourself! Buy Lubri-Tasgon at your local Mill Supply House or send 10c for sample to Samuel Cabot, Inc., 1604 Oliver Bldg., Boston 9, Mass.

LUBRI-TASGON

of the power transmission div with Lovejoy. Dr Homer Squire Weber has been made professor and head of mechanical engineering dept at **Georgia Tech**.

Paul H Davey, president, **Davey Compressor Co,** announced the appointment of Ernest S Theiss as assistant chief engineer.

A new firm, **Fleishman, Hillard & Associates,** has been formed in St. Louis with special attention to be given to public relations problems in privately owned public utilities.

Graver Tank & Mfg Co has announced appointment of Edward B Heyden as head of the construction div and John E Fogarty as general manager of the Sand Springs, Okla., plant.

R C McDonald has been added to the New York staff of **Pacific Pumps, Inc. Pennsylvania Flexible Metallic Tubing Co** opened an office in Syracuse for the Penflex Sales Co div, under William V Pyndus as manager.

W Stuart Johnson has joined **A O Smith Corp** as manager of hydraulic products sales in the Pacific Coast district.

Alloy Steels Products Co has appointed Emil G Holmberg as consulting metallurgist.

General Electric Co, welding div, has opened a Houston, Tex., office with F C Neal, Jr, manager. A further announcement states that sale of permanent magnets and metallurgical products is a function of the chemical dept.

William M Rand, **Monsanto Chemical Co,** president, announces that John L Gillis, vice-president, Johnson & Johnson International, has joined Monsanto.

J C Leonard became sales manager of **Oakite Products, Inc,** industrial marketing div, Sept 1, according to a recent release.

Factory engineer for **Allen B DuMont Laboratories, Inc** will be Edward A Ossman in the New York territory with headquarters at Rochester, the company has announced.

OBITUARIES

Charles F Wallace, 75, former chief engineer, Stone & Webster, Boston, Mass., and later a junior partner and vice-president after its incorporation as Stone & Webster, Inc died, Sept 11, at Whitefield, N. H.

Grover F Ilgen, 58, vice-president and general sales manager of Airetool Mfg Co, died Aug 27 in University hospital, Columbus, O.

Dr A R Stevenson, Jr, staff assistant to General Electric Co's vice-president in charge of engineering policy, died suddenly at Ellis Hospital, Schenectady, Aug 18. He was 53.

These well-known plants use COCHRANE MULTIPORT RELIEF VALVES . . . Do you?

HERCULES POWDER CO.
"Operation of Cochrane Valve is smooth; pulsation and vibration have stopped."

ROYAL BAKING POWDER CO.
"No maintenance in 7 years."

SCOTT PAPER CO.
"Selected because of satisfactory service of an earlier Cochrane Multiport."

CONNECTICUT LIGHT & POWER CO.
"Former valve stuck open frequently . . . the Cochrane Multiport works perfectly."

BEECHNUT PACKING CO.
"25 years of service. No other comment."

SHEFFIELD FARMS CO.
"In service about 20 years with no maintenance."

ALAN WOOD STEEL CO.
"Opening and closing every 30 seconds with but little interruption for more than 12 years."

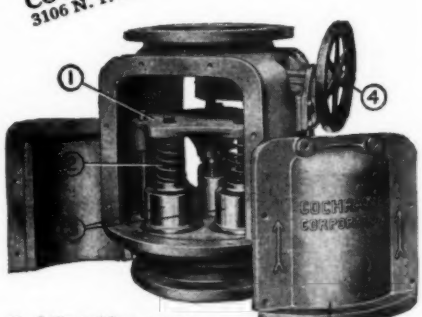
COCHRANE
SINCE 1863

MULTIPORT RELIEF VALVES

The Cochrane Multiport Relief Valve gives absolute insurance against overpressure and consequent damage that may result from the use of single disc relief valves subject to sticking, jamming, overweighting or tying down. They provide this protection for backpressure, atmospheric relief, flow or check valve service and are applicable for use with steam, water, air or gas.

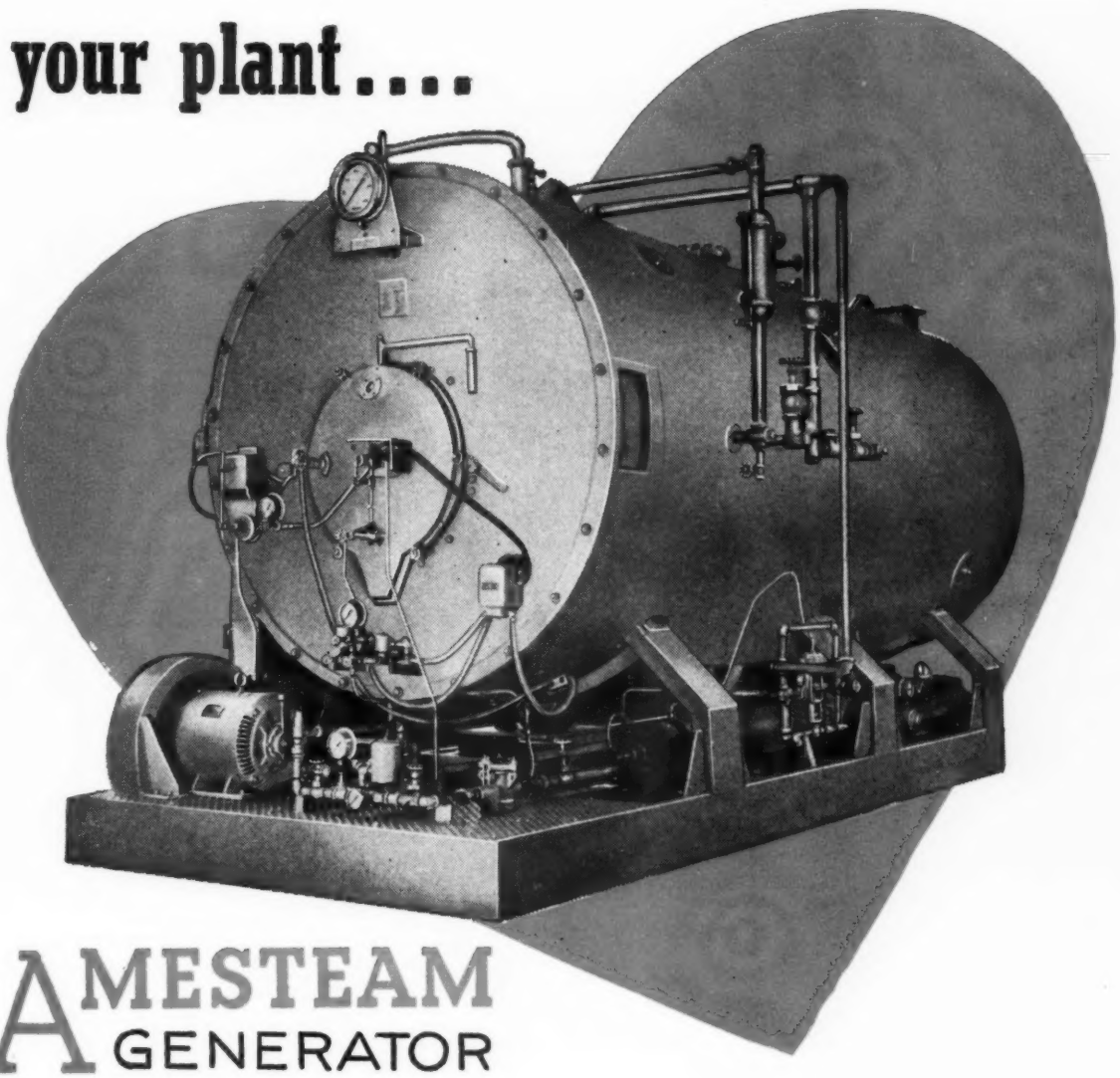
Write for new Publication 4150

COCHRANE CORPORATION
3106 N. 17th St. Philadelphia 32, Pa.



1. Adjustable pressure plate.
2. Individual spindles and springs.
3. Multiple valve discs instead of one large disc.
4. Adjusting hand wheel.

the "Heart" of your plant....



AMESTEAM GENERATOR

Your boiler is the "heart" of your plant, so choose carefully to keep this vital piece of equipment running efficiently year after year.

The AMESTEAM Generator has built into it many features proven and tested during our 100 years experience in boiler design, fabrication and operation.

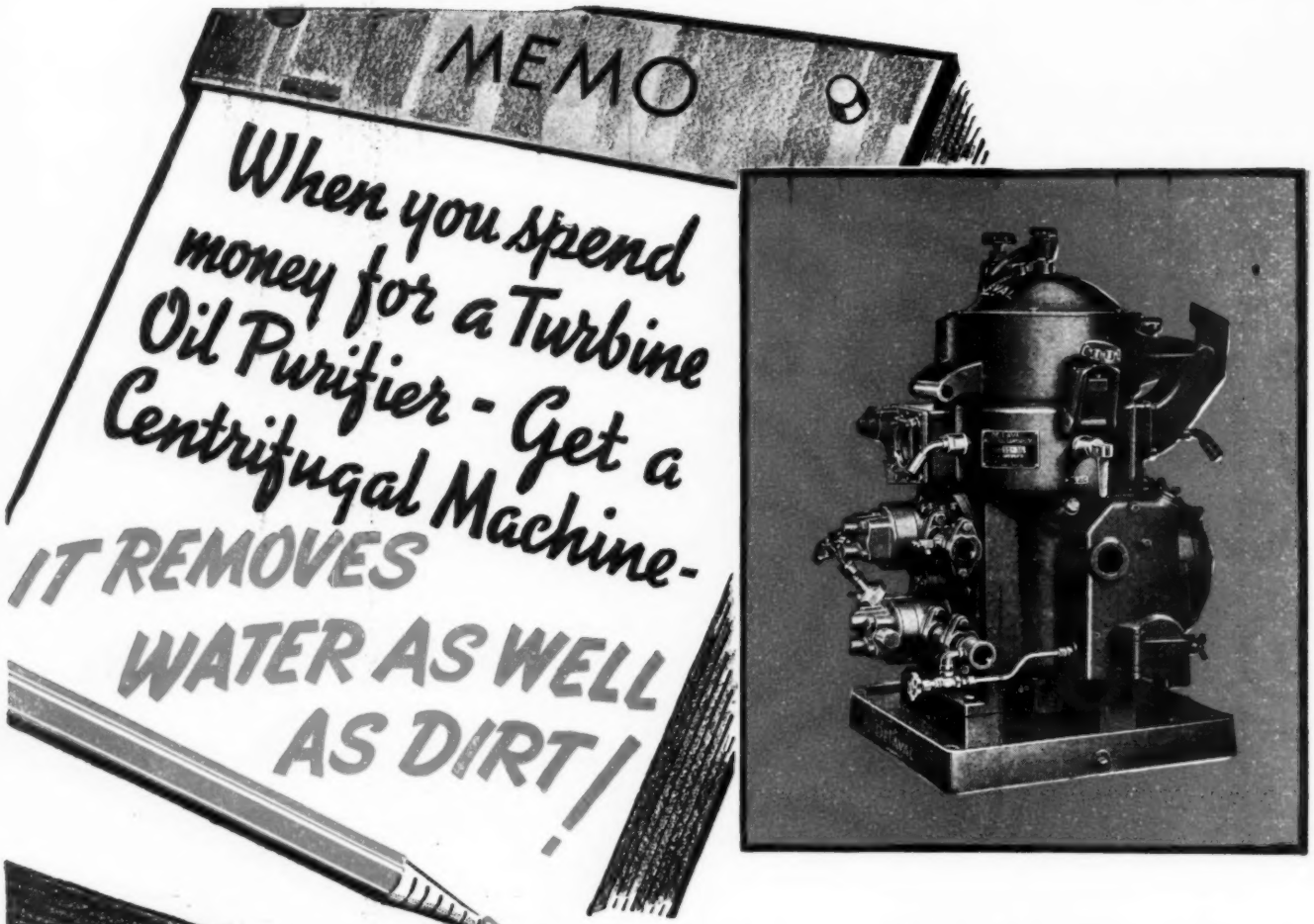
The AMESTEAM unit is rugged, yet simple in design and operation. All parts are easily accessible for inspection or maintenance. Units are available for firing with any standard grade fuel oil or gas, in sizes from 10 to 300 H.P. and pressures from 15# to 200#.

Investigate the AMESTEAM Generator and contact us for full details on units to meet your requirements.

A Complete Return to the Boiler System, including Feed Water Pump and Condensate Tank with their accessories, is part of the standard equipment with every standard AMESTEAM Generator.

AMES IRON WORKS

BOX B-11 • OSWEGO • NEW YORK



Consider the advantages of providing your power unit with a De Laval Oil Purifier. The Purifier is a machine wholly mechanical in action. It requires no periodic replacement of functional parts to maintain its working efficiency. It separates out dirt from the oil instantaneously and discharges the clean oil continuously.

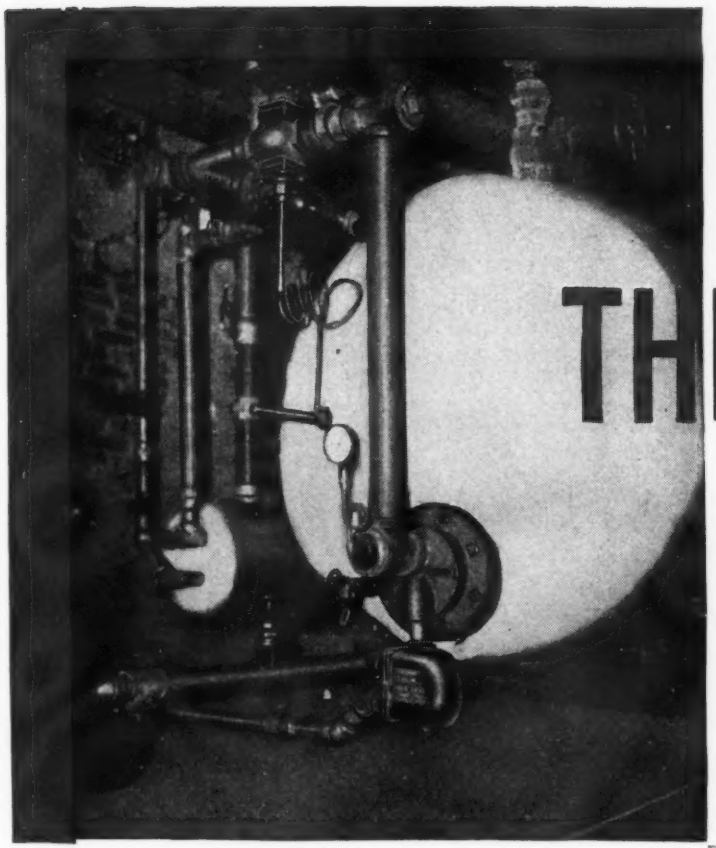
And It Removes Water Continuously at the same time. This is of great importance in the purification of turbine oils, for water in turbine oil is a prime source of sludge formation. And should a sudden water leak occur, really serious damage through emulsification will be prevented by the Oil Purifier. A De Laval unit of proper size has ample capacity to remove sudden "slugs" of water.

That is complete protection—removal of dirt ***and*** water. Since protection costs a fraction of what trouble does, why be satisfied with anything less than the best?

DE LAVAL

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

LUBRICATING OIL PURIFIERS



THE LUXURY

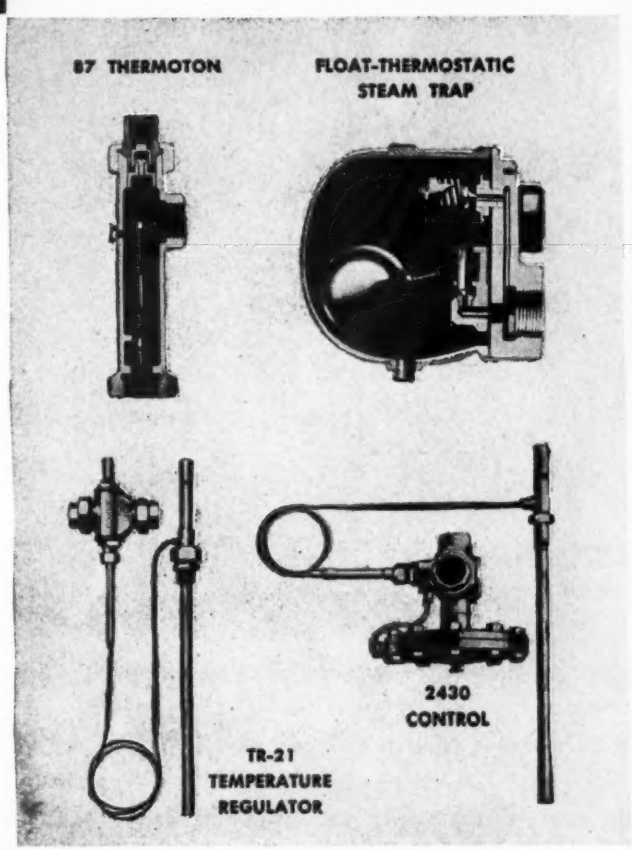
AND ECONOMY *of Correct Temperatures* AT LESS COST

This is the story of a Maintenance Engineer who has ceased to worry about heating and hot water temperatures because he knows how to use the various forms of Sarco steam traps and temperature control.

The large storage heater is controlled by the Sarco TR 21 Temperature Regulator and drained by the Sarco Float-thermostatic trap shown at right. At the rear is a hot water converter for the heating system held to exact temperature by a Sarco 2430 temperature regulator.

At other points the low cost Sarco 87 Thermoton is used to insure correct temperatures for food warming and satisfactory temperatures on incidental showers served by instantaneous heaters. In fact, Sarco is now standard throughout the shops, office and real estate holdings. It's a case where Sarco products work together as a team to produce permanent satisfaction and savings. All this engineer had to do in the beginning was to make one phone call—to the local Sarco representative.

132

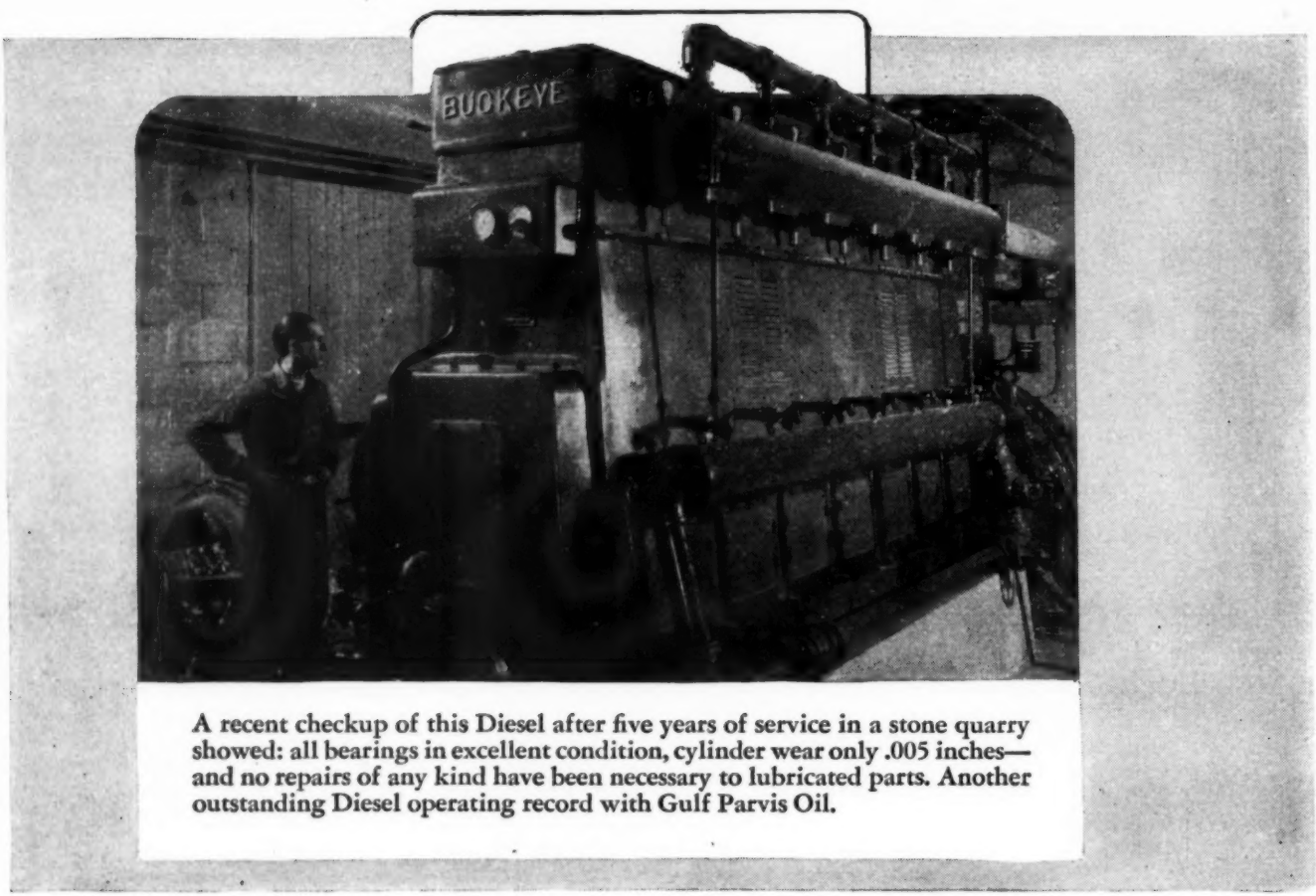


SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
475 FIFTH AVE., NEW YORK 17, N. Y.
SARCO CANADA, LTD., TORONTO 1, ONTARIO

Performance records

back up your judgment when you select GULF PARVIS OIL to lubricate your Diesels



A recent checkup of this Diesel after five years of service in a stone quarry showed: all bearings in excellent condition, cylinder wear only .005 inches—and no repairs of any kind have been necessary to lubricated parts. Another outstanding Diesel operating record with Gulf Parvis Oil.

THE unit pictured here is one of hundreds of industrial and marine Diesels that have operated with greater efficiency and economy over a period of years with Gulf Parvis Oil in service.

Now modern petroleum technology has made possible a further improvement in Gulf Parvis Oil! This quality oil has higher lubricating value for more effective protection—greater resistance to oxidation for longer lasting protection—and is nonfoaming. Every one of these features will insure better lubrication for your Diesels!

Gulf Parvis Oil is available to you through 1200 warehouses located in 30 states from Maine to New Mexico. Call in a Gulf Lubrication Service Engineer and ask him to recommend the proper grade to fit your particular requirements. Write, wire, or phone your nearest Gulf office today.

Gulf Oil Corporation · Gulf Refining Company

Division Sales Offices:

Boston · New York · Philadelphia · Pittsburgh · Atlanta
New Orleans · Houston · Louisville · Toledo

GULF INDUSTRIAL LUBRICATION

in for a LONG STRETCH

with CHASE ANTIMONIAL ADMIRALTY*

Zinc's days of vagrancy are over!

Little chance, now, for this footloose element to work its way out of Admiralty Condenser Tubes, leaving a useless mass of soft, spongy copper in its wake.

Little chance, if the tubes are Chase *Antimonial* Admiralty. The antimony in *these* tubes keeps the zinc locked in, year after year.

Proof? Plenty of it! Chase Antimonial Admiralty Tubes first went into service in 1935. Millions of pounds have been installed. And you could count the dezincification failures on the fingers of one hand—and have some fingers left over!

That's the sort of service you want from *your* condenser tubes, isn't it? You can get it . . . at an initial cost no greater than for *plain* Admiralty. Just be sure to specify *Chase Antimonial Admiralty.*

*U. S. Pat. No. 2,061,931

Special stocks of ANTIMONIAL-ADMIRALTY Condenser Tubes in Chase Warehouses at LOS ANGELES, NEW ORLEANS SAN FRANCISCO also carried by— Vinson Supply Co., TULSA Standard Brass & Mfg. Co. HOUSTON

Chase
BRASS & COPPER CO.

Waterbury 91, Connecticut
SUBSIDIARY OF KENNECOTT COPPER CORPORATION

INCORPORATED

This is the Chase Network—handiest way to buy brass

ALBANY† ATLANTA† BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS JACKSONVILLE† KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WASHINGTON† (†*Indicates Sales Office Only*)

LARGE DIAMETERS

FOR *EXTRA* YEARS OF MAXIMUM

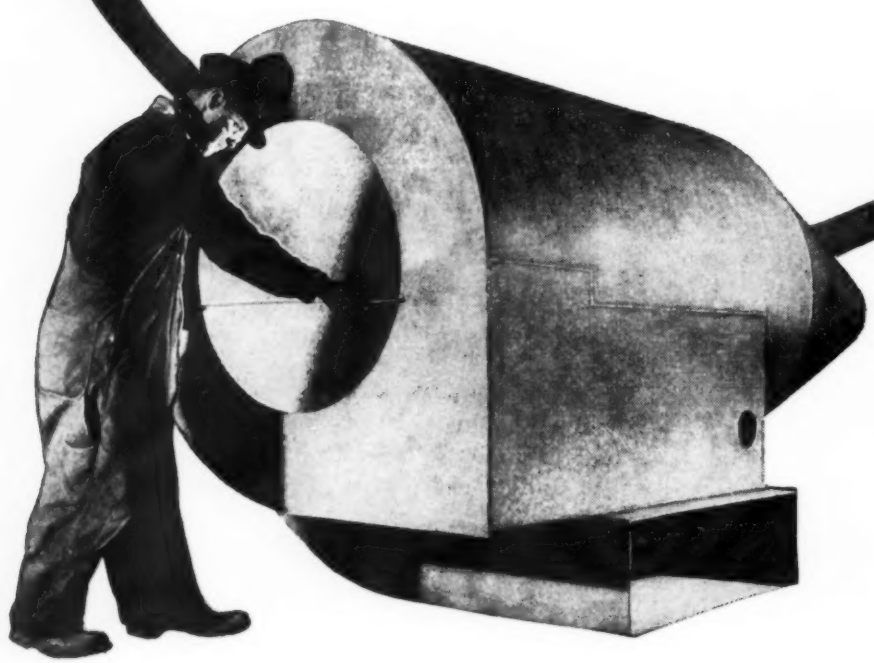
Dust recovery

Because of Buell's exclusive feature—the patented van Tongeren "shave-off"—the cyclones in Buell Dust Recovery Systems do not have to be made with small diameters in order to achieve high recovery efficiency. On the contrary, diameters of Buell cyclones can be in excess of four feet without loss in efficiency.

These large diameters make possible operation with low centrifugal force and consequent reduction in abrasive wear; and permit one-piece construction of extra-thick steel, with large duct outlets, that makes clogging virtually impossible.

All these are prime factors in the trouble-free operation, low maintenance cost, and high efficiency of custom built Buell Dust Recovery Systems—as established from actual records of installations in service for three, four, five or more years.

Buell's book—"The van Tongeren System of Industrial Dust Recovery"—illustrates and explains the patented van Tongeren principle and its many applications to industry. We will be pleased to send you a copy without charge. Write for it today.

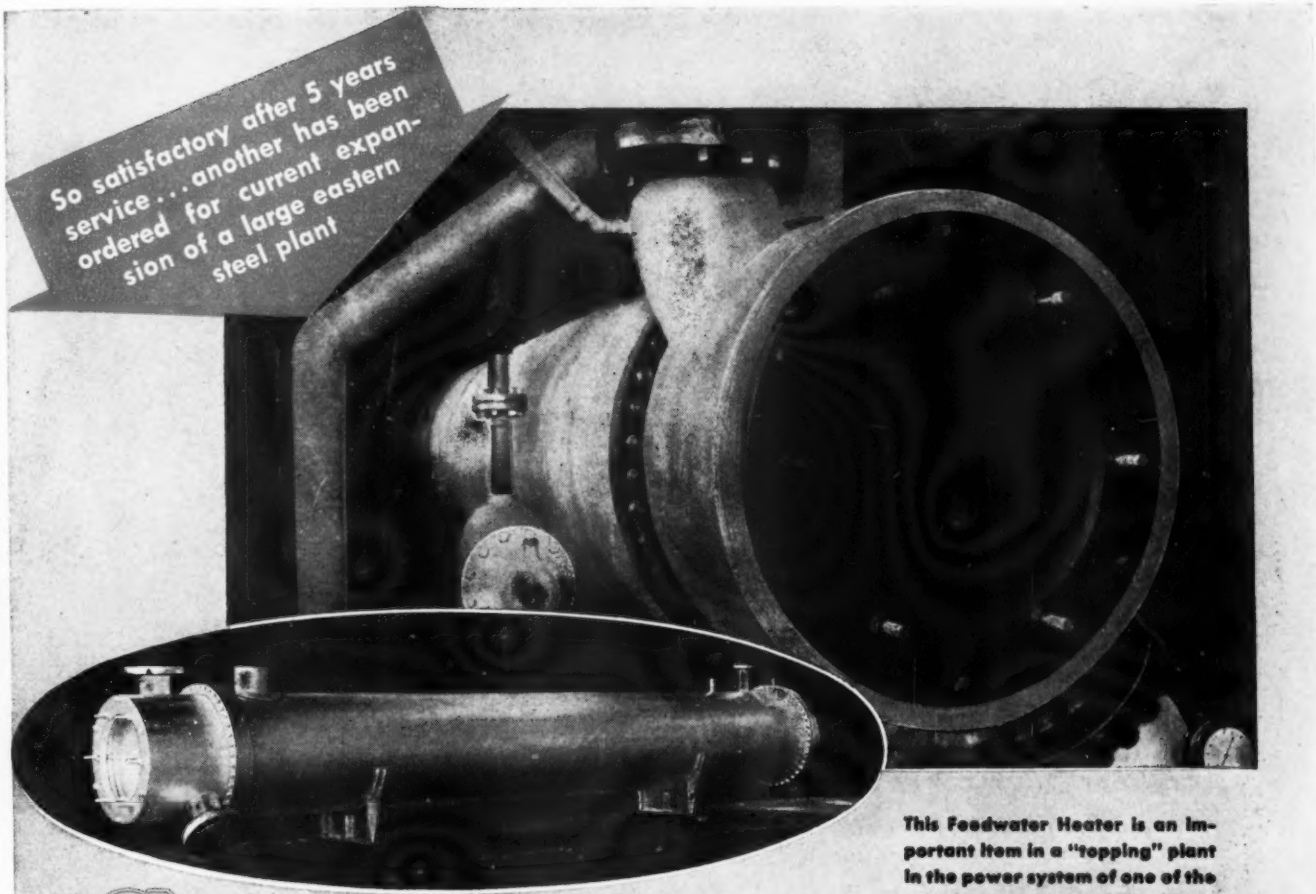


Six Exclusive Buell Features

1. THE "SHAVE-OFF"
2. ✓ LARGE DIAMETERS
3. EXTRA-STURDY CONSTRUCTION
4. CORRECT HOPPER DESIGN
5. SPLIT-DUCT MANIFOLDING
6. INNER WELDS GROUND SMOOTH

BUELL ENGINEERING COMPANY, INC.
10 Cedar Street, New York 5, N. Y.
Sales Representatives in Principal Cities

buell DUST RECOVERY SYSTEM



This Feedwater Heater is an important item in a "topping" plant in the power system of one of the most progressive steel mills in the country.

SW STRUTHERS WELLS *high pressure* FEEDWATER HEATERS

The "Boltless Head" closure handles a normal feedwater pressure of 1100 p.s.i., on this 44" diameter heater. It is also employed on the floating head, where it will also withstand an external pressure of 500 p.s.i. with no pressure inside the head. After five years of service, no difficulties have been encountered with this closure, and it has always remained tight.

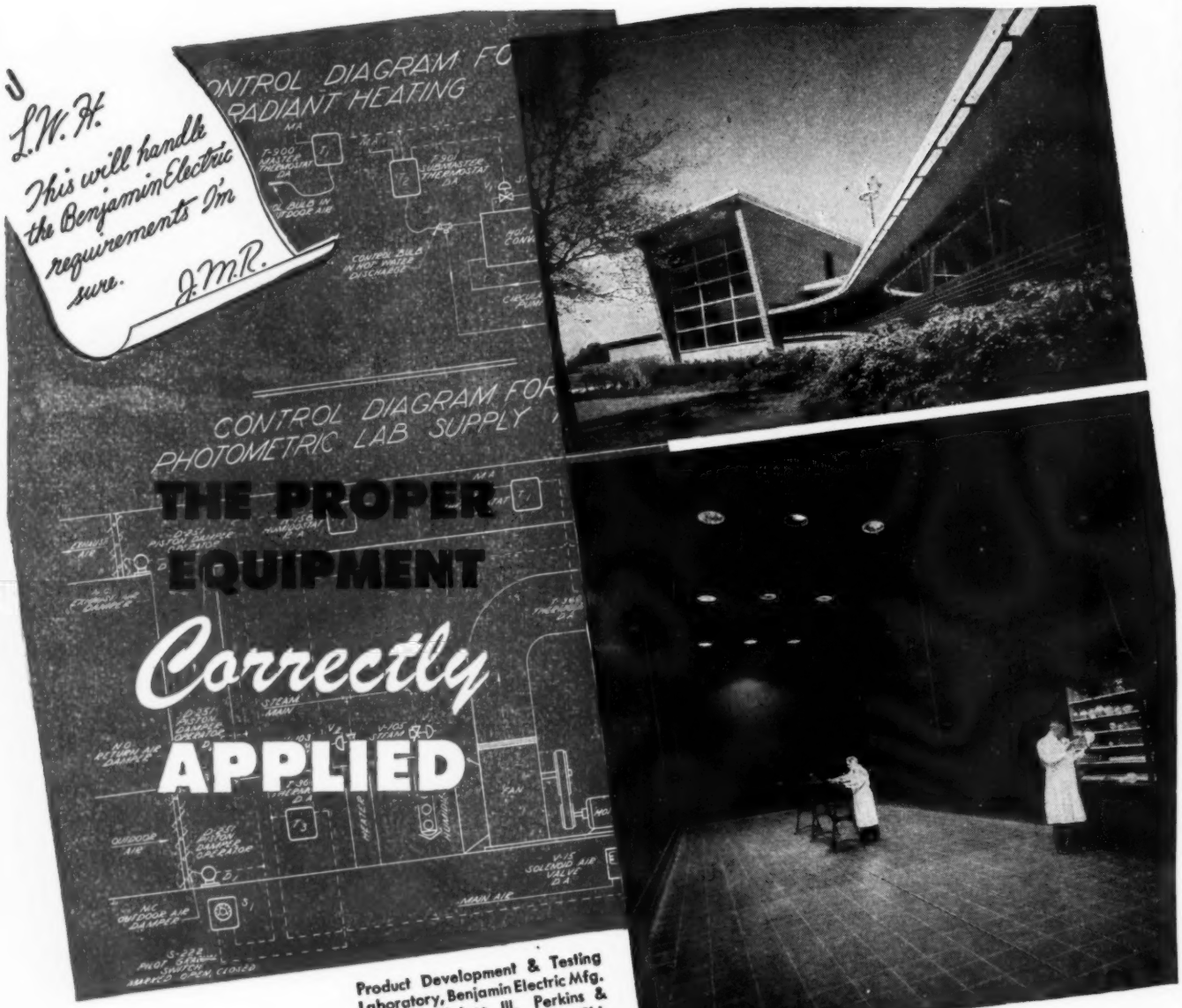
Both desuperheating and subcooling sections are provided in this heater, with a designed rise of 132°F. for the Feedwater through the heater. Performance exceeded guarantees.

With 100 per cent make-up, cleaning once a year has been found sufficient.

For a current extension, an additional heater, essentially duplicating the above is now being furnished.

Write for Bulletin B-17 Technical Information

STRUTHERS WELLS CORPORATION
PROCESS EQUIPMENT DIVISION
WARREN, PENNA.
PLANTS AT WARREN, PENNA. AND TITUSVILLE, PENNA.


L.W.F.
This will handle the Benjamin Electric requirements I'm sure.
J.M.R.
CONTROL DIAGRAM FOR RADIANT HEATING
CONTROL DIAGRAM FOR PHOTOMETRIC LAB SUPPLY
THE PROPER EQUIPMENT Correctly APPLIED

Product Development & Testing Laboratory, Benjamin Electric Mfg. Co., Des Plaines, Ill. Perkins & Will, Architects-Engineers, Chicago, Illinois. Photographs by Hedrich-Blessing Studio.

The purpose of Benjamin Electric Manufacturing Company's new $100,000 Laboratory is "to contribute to the advancement of the science and art of illumination." The building embodies many new and unique advancements in construction, equipment and design. The keynote of the building itself—and of the work which is to be performed there—properly may be said to be "The Proper Equipment . . . CORRECTLY APPLIED." And that, too, is the keynote of Johnson Systems of automatic temperature control.

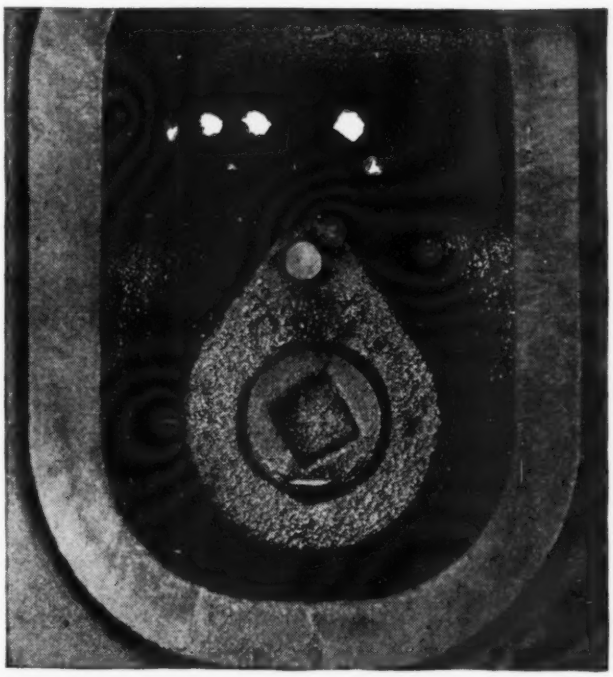
In this interesting building, Johnson Control for Radiant Heating varies the temperature of the water supplied to the heating surfaces according to the outdoor temperature. This assures a change in the heat input to the radiant surfaces immediately upon a change in weather conditions. Irritating "thermal lag" is overcome. . . . For the Photometric Laboratory, Johnson Control of the central plant air conditioning system is extremely important because of the facts that the area is windowless and devoted to precise instrument work. Provision is made for the automatic regulation of future cooling coils.

The hook-up diagrams for the guidance of engineer, installation mechanic and operator—reproduced above—are typical of Johnson-engineered installations. Ask us to help solve *your* next temperature control problem. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

Diesel Engine DANGER points



Air ports clogged after operation on uncompounded oil.

Clogged Ports Reduce Efficiency

To the operator of a two-cycle Diesel engine, the clogging of air ports can become a serious problem. Deposits on air ports are composed largely of fuel soot and oxidized products. These contaminants reach the lower cylinder when sluggish or stuck piston rings permit blow-by.

RPM DELO Oil Prevents Air Port Deposits

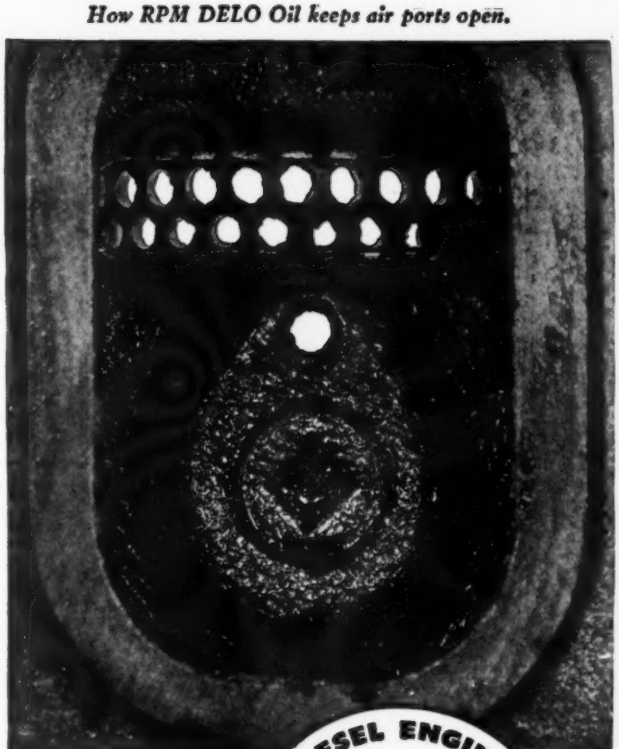
RPM DELO Oil keeps air ports clean three ways:

1. By reducing ring wear (RPM DELO Oil is compounded to cling to scorching wear points which most oils leave bare).

2. By preventing ring-sticking (a detergent in RPM DELO Oil eliminates the deposits which stick rings).

3. By preventing oxidation of the oil (RPM DELO Oil's anti-oxidant compound controls the gummy substances which act as a binder for deposits).

How RPM DELO Oil keeps air ports open.



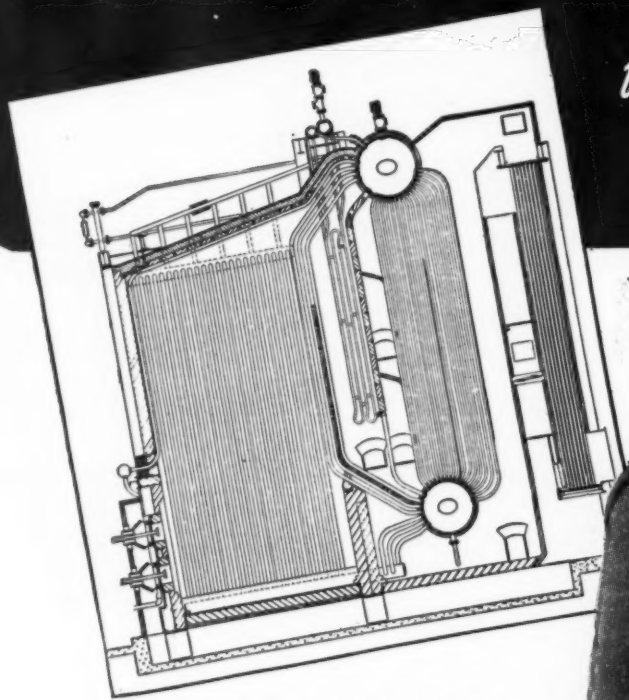
DIESEL ENGINE RPM DELO LUBRICATING OIL

To match the fine performance of RPM DELO OIL, use these equally efficient companion products from the same famous "RPM" line—RPM HEAVY DUTY MOTOR OIL —RPM COMPOUNDED MOTOR OIL—RPM GEAR OILS AND LUBRICANTS—RPM GREASES. For additional information or name of your distributor, write any of the companies below:

STANDARD OF CALIFORNIA • 225 Bush St., San Francisco 20, California
THE CALIFORNIA COMPANY • 17th and Stout Streets, Denver 1, Colorado
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA OIL COMPANY • 30 Rockefeller Plaza, New York 20

ROTO TUBE CLEANERS

for EDGE MOOR *Vertical Flow* Bent Tube Boilers



Edge Moor Vertical Flow Unit with Edge Moor Superheater and Air Preheater arranged for liquid fuel firing

Leading boiler manufacturers have furnished . Roto . Tube . Cleaners . as standard equipment for over 35 years. Some of the original cleaners are still giving good service. Whatever your requirements, our experience gained by long specialization in tube cleaners assures you of satisfactory service.

. . Illustrated here are an Edge Moor Vertical Flow Bent Tube Boiler and the Roto Tube Cleaners which we specify for this unit. We can ship these and many other types and sizes of tube cleaners i m m e d i a t e l y from stock. Write, wire or phone.

ROTO TUBE CLEANER SPECIFICATION:

(Above) Roto Model 22E Air-driven Motor with 478-K pivot head for 2" rear bank boiler tubes.

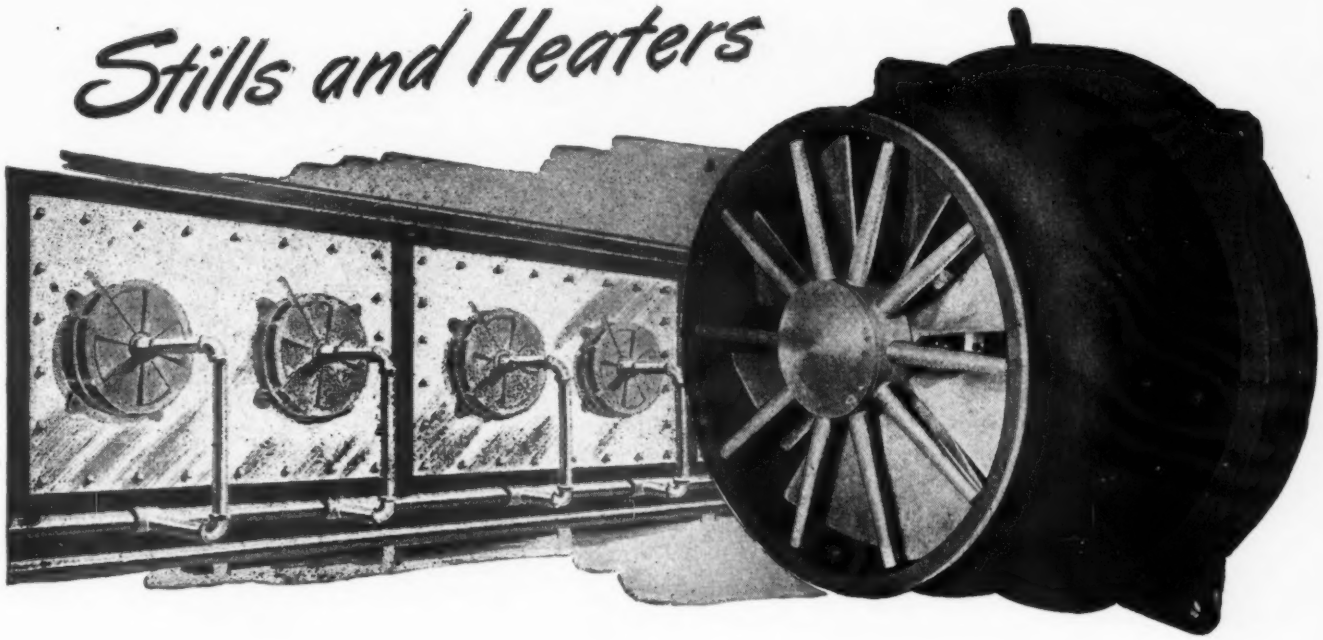
(At left) Roto Model 130 Air-driven Motor with S-50 swing-frame head for 3¼" water-wall tubes and front bank of boiler tubes.

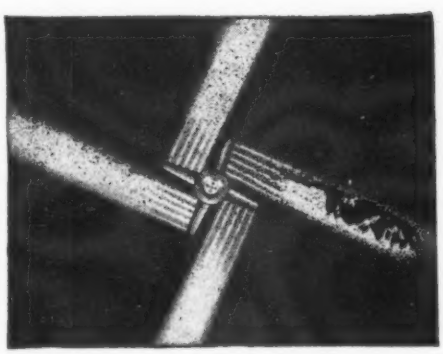
ROTO Division of ELLIOTT COMPANY

153 SUSSEX AVENUE - - - NEWARK 1, N. J.

"BUNSEN'S DREAM" UPS THRU-PUT OF

Stills and Heaters





Bunsen, developer of the first gas burner, believed that "An ideal gas burner is one in which there would be an infinite number of gas orifices interposed across the air stream." And that is as close a description as you could get of the Coppus-Dennis FANMIX Burner.

The exclusive "pinwheel action" principle of FANMIX produces a perfectly combustible mixture of air and gas that results in:—

1. Complete combustion with less than 5% excess air.
2. Greater heat release.
3. Total absence of drifting "hot spots"

Here's how FANMIX works. Fuel escaping from orifices in rotating driver arms, rotates the fan which draws in air at right angles to the path of the fuel. The energy of the fuel under pressure is utilized to perform work by mechanically mixing and proportioning the fuel with just the required amount of air.

Increase Rating of Old or New Equipment

Coppus engineers FANMIX Burners for individual application. Complete control over rate of combustion or flame pattern can be provided to meet requirements of any installation. Straight gas and combination gas-oil burners available; combination burners burn either oil or gas in entirety or in any proportion. No oil guns needed.

Send for the Coppus-Dennis FANMIX Bulletin 410-4. Coppus Engineering Corporation, 411 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in SWEET'S, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

On New Installations, Fanmix Saves

1. **COMBUSTION SPACE.** With FANMIX the furnace does not have to serve as a mixing chamber.
2. **STACK HEIGHT.** With FANMIX there is no draft loss across the burner.
3. **INSTALLATION COSTS.** With FANMIX you can use smaller pipe sizes, need no forced draft equipment, etc.

More than 93% of 191 petroleum refinery plants built for war, use Coppus equipment.

ANOTHER

COPPUS

"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP.
411 Park Ave.,
Worcester 2, Mass.

FREE BULLETIN

Please send Bulletin 410-4 to

Name.....

Company.....

Address.....

NO OTHER EXPANSION JOINT IS LIKE IT

E. B. Badger & Sons Company is the original and sole manufacturer of BADGER Expansion Joints

DIRECTED FLEXING equalizing rings are a *patented* — hence exclusive — feature of Badger Packless Corrugated Expansion Joints. In combination with another Badger feature —ALL-CURVE corrugations—they "harness" expansion, contraction and vibration stresses more dependably, more economically, more permanently than any other known means of handling this vital pipeline problem.

Excessive stresses in high-temperature or high-pressure lines simply can't get out of hand. They can't pile up in pockets or junctions—because Badger *ALL-CURVE Corrugations* have no pockets or junctions. Then, *ALL-CURVE Directed Flexing Rings* complete the even distribution of stresses — among all the corrugations of the joint — and furthermore provide a fixed safety limit to movement and pressure.

Badger Packless Directed Flexing Corrugated Expansion Joints are built with known factors that leave nothing to guesswork. You can readily determine the number of corrugations needed, since the maximum traverse per corrugation is consistent for each size. For example:

Diameter	*Depth of Corrugation*	*Traverse per Corrugation*
4" and 5"	1⅛"	5/16"
6"	1¾"	½"
8" and 10"	2¼"	5/8"
12" and larger	2¾"	¾"

MADE IN COPPER, STAINLESS STEEL AND OTHER ALLOYS — Copper for normal pressures and temperatures; Stainless Steel and other alloys for higher requirements — and where corrosion is a problem. Single or multiple corrugations — for traverses from a fraction of an inch upward. Also made in Non-equalizing type (without rings) for uses that do not require added protection. SEND FOR BULLETIN No. 100 (*Self-equalizing*) or No. 200 (*Non-equalizing*).

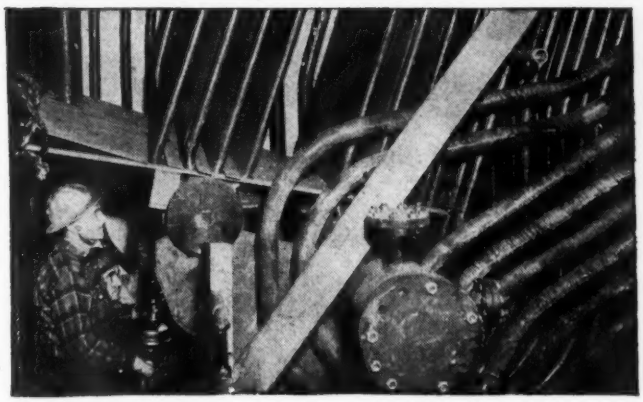
E. B. BADGER & SONS CO., 75 Pitts Street, Boston 14, Mass.

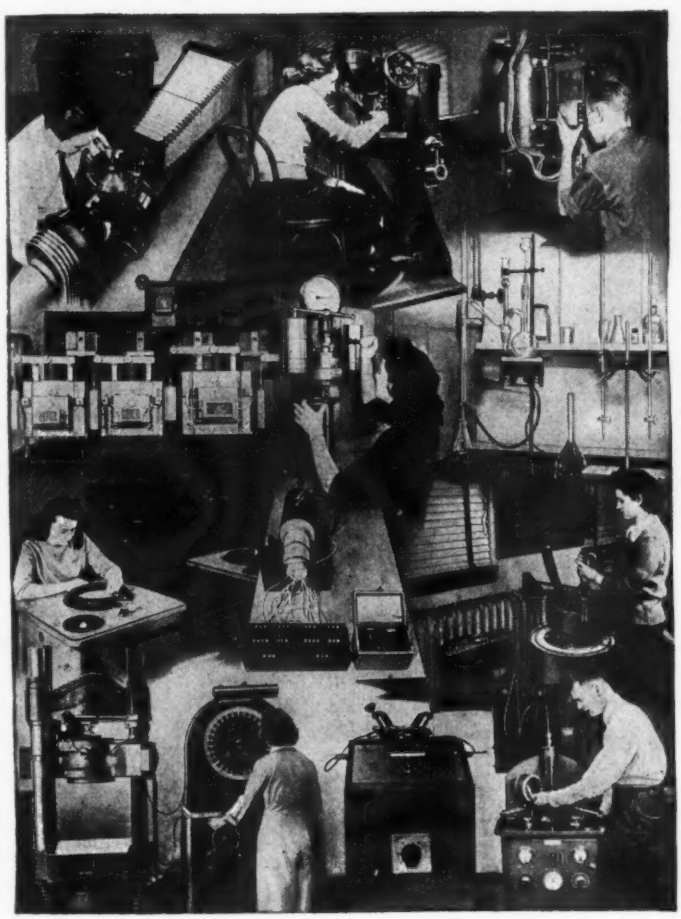
AGENTS IN PRINCIPAL CITIES

Badger

PACKLESS CORRUGATED EXPANSION JOINTS

Why it pays to bring tube problems to B & W





BABCOCK & WILCOX is a logical place to turn for sound, practical answers to all problems concerning pressure tubes for power plant equipment — for a number of good reasons.

First, because so many *do* bring their tube questions here—and have for 35 years—B&W can answer yours in the light of exceptionally broad experience in supplying BOTH Seamless *and* Welded pressure tubing for every purpose in steam generating and heat transfer units.

And... this B&W experience embraces an exceptionally wide range of steel analyses, several of them available from no other source—from simple low carbons to high alloys that include, stainless and other corrosion-resistant steels, carbon-molybdenum steels and many special B&W Croloys.

B&W suggestions for matching tubes to power plant equipment are impartial—based only on what tubing properties are best for each combination of corrosion, oxidation, heat resistance, creep strength and other conditions.

You can count, too, on B&W data being up-to-the-minute, for day in, day out, technicians in B&W's large, complete tube laboratories are constantly searching for still better alloys that will extend tube life, reduce maintenance, and increase tubing dependability and economy.

Make the expertly staffed B&W laboratory your "question and answer department" on any tube problems.

TA-1323

Other B&W Products

THE BABCOCK & WILCOX CO.

85 LIBERTY STREET • NEW YORK 6, N. Y.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service • Water-Cooled Furnaces • Superheaters • Economizers • Air Heaters • Pulverized-Coal Equipment • Chain-Grate Stokers • Oil, Gas and Multi-fuel Burners • Refractories • Process Equipment.

BABCOCK & WILCOX

SEAMLESS & WELDED TUBES

THE BABCOCK & WILCOX TUBE COMPANY

GENERAL OFFICES: BEAVER FALLS, PA.

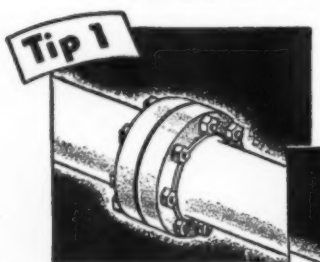
PLANTS: ALLIANCE, OHIO AND BEAVER FALLS, PA.

"Featherweight" 85% Magnesia application in a large distillery, where temperatures must be accurately controlled . . . showing insulated drum ends, water wall piping and headers.

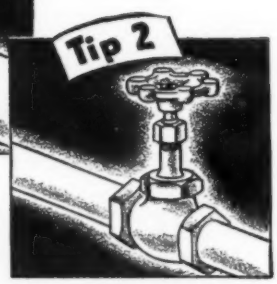
How to S-T-R-E-T-C-H your fuel supply

K&M "Featherweight" 85% MAGNESIA

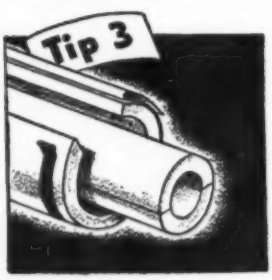
3 TIPS TO HELP YOU SAVE FUEL!



COVER THOSE FLANGES!
On a 10" line at 150 lbs. steam pressure, you can save *approximately ½ ton of coal per flange* per year . . . simply by insulating all bare flanges with "Featherweight!"



COVER THESE, TOO!
Similarly, gain further fuel savings by covering all valves, elbows and other fittings in the steam lines.



SPECIFY THE BEST
To be sure of maximum fuel efficiency, minimum heat loss, be sure all lines are covered with "Featherweight" 85% Magnesia.

With coal so hard to get these days . . . and *all* fuel a costly item . . . it's more important than ever to squeeze that last BTU out of your fuel supply.

You can be sure of minimum heat loss and low fuel consumption if you standardize on K&M "Featherweight" 85% Magnesia insulation. Designed for pipes carrying up to 600°F., "Featherweight"—under various service conditions—has proved to be the most efficient insulation of the moulded type. It is light in weight, fire-proof and extremely durable.

Send for full technical information about "Featherweight" . . . and find out how it can help you gain more power with less fuel, at less cost.

Nature made Asbestos . . .
Keasbey & Mattison has been making it serve mankind since 1873.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

ENGINEERING PROGRESS REPORT #5

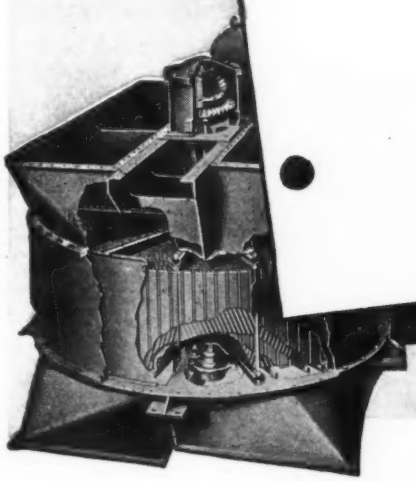
LJUNGSTROM AIR PREHEATER

Savings Begin With Installation

In selecting a preheater, after factors of all-over design have been properly weighed, it is well to consider these capital expenditures:

CAPITAL EXPENDITURES

1. FIELD. Because the Ljungstrom is fabricated at the factory as a unit, installation expenditures are lower.
2. There are building and structural savings possible because the Ljungstrom is smaller and more adaptable to a large variety of layouts.



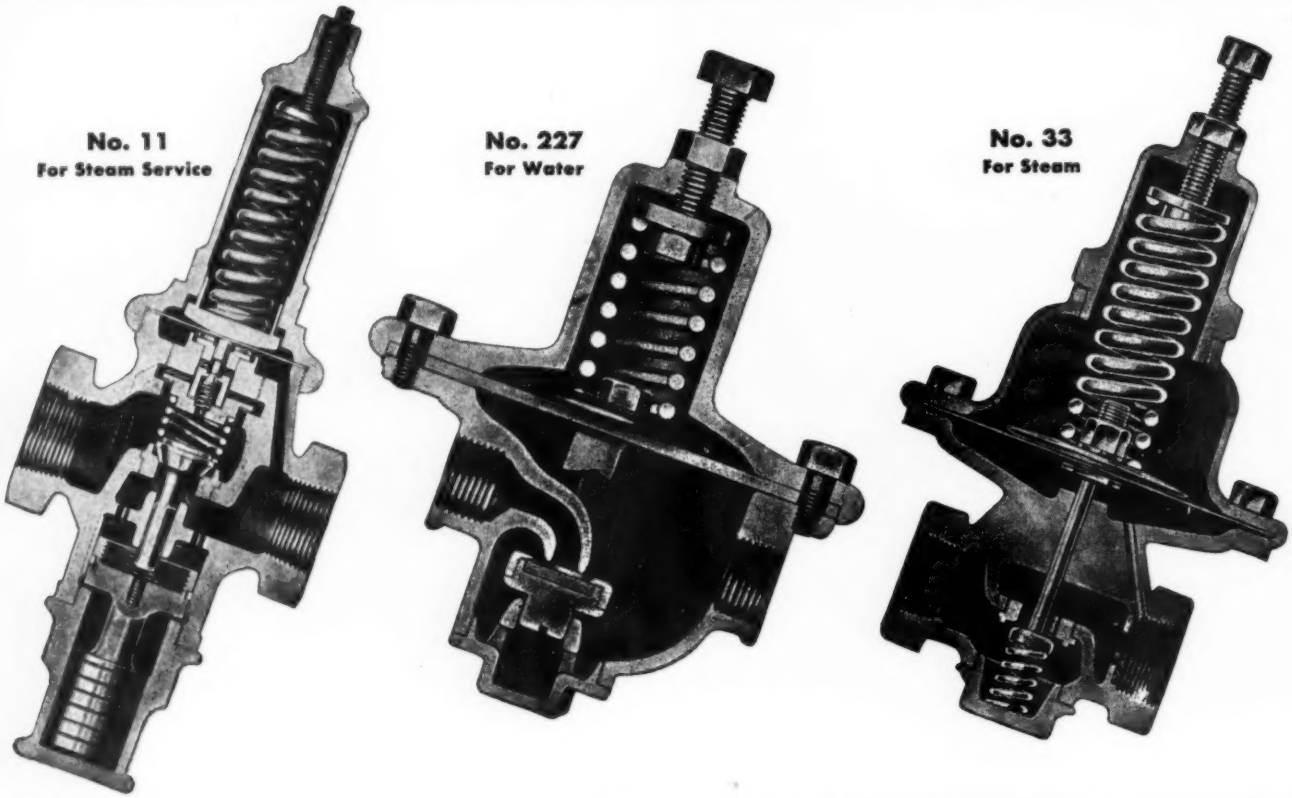
THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

A GOOD TIP...



"Masoneilan Regulators for Maintaining Accurate Pressures and Cutting Costs in Pressure Reducing Service"

Large or small . . . whatever the size of your plant . . . you can depend on Masoneilan Regulators to maintain desired pressures even in spite of fluctuating loads. Their accurate performance in steam, water and air service cuts operating expenses by reducing waste. Their rugged construction assures long life and exceptionally low maintenance costs.

Take a tip from the countless plant operating men . . . use Masoneilan Regulators for all types of pressure reducing service. Catalog No. 73 gives complete information on these and other types of Masoneilan Regulators. Write for your copy, today.

MASON-NEILAN REGULATOR CO.

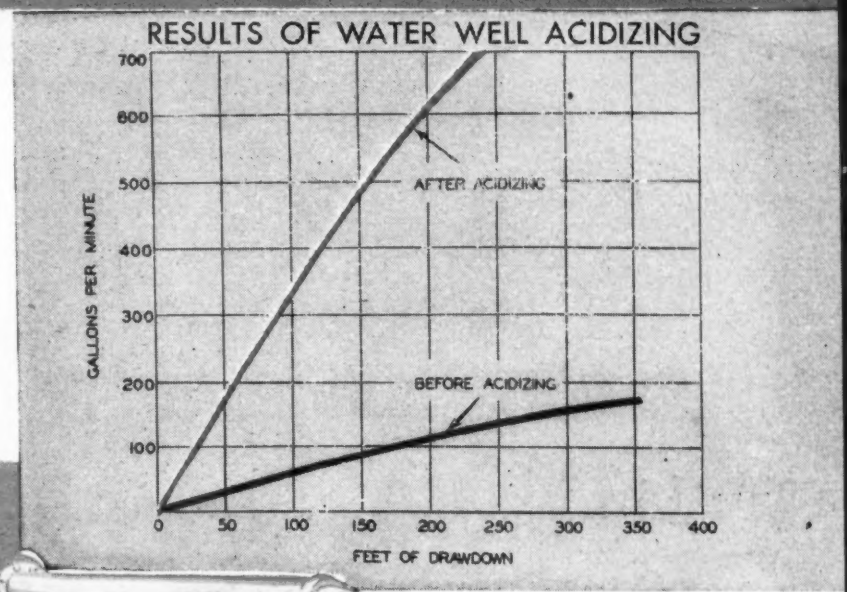
1186 ADAMS STREET, BOSTON 24, MASSACHUSETTS

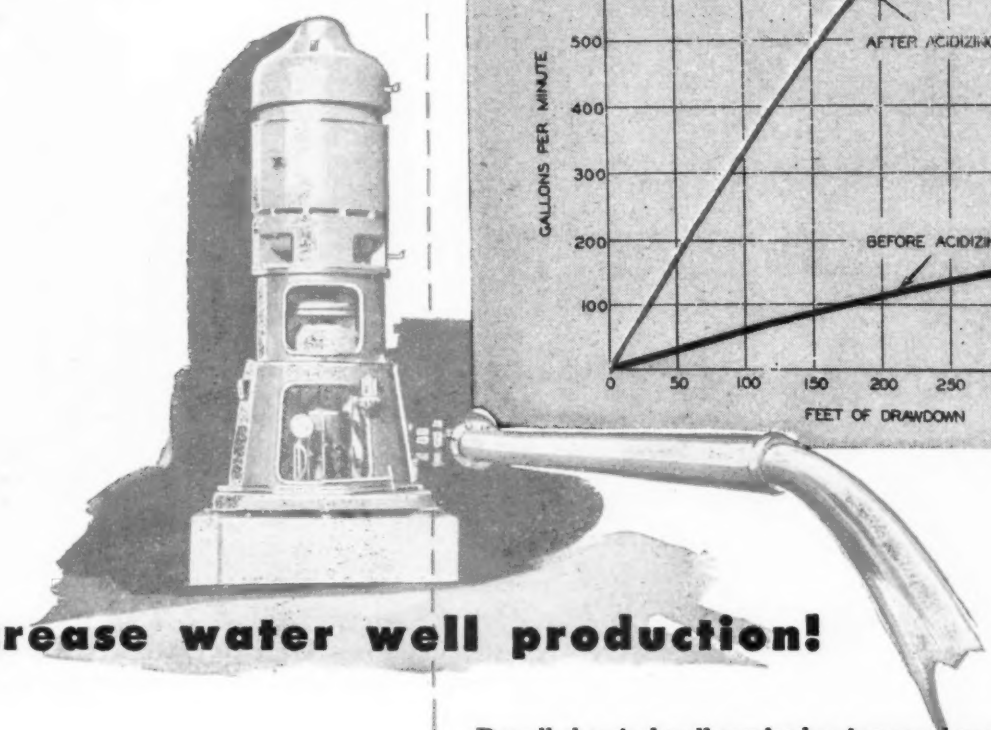
MASONEILAN

New York Philadelphia
Buffalo Pittsburgh Tulsa Cleveland Chicago Atlanta
St. Louis San Francisco Los Angeles Houston
Mason Regulator Co. of Canada, Ltd., Montreal and Toronto

DOWELL

Drawdown Curves showing the advantages to be obtained from proper chemical treating of water wells.





increase water well production!

Dowell chemical well service has increased production from thousands of water wells. The removal of retarding incrustations on screens and the enlarging of formation pores by chemical treatment permits more water to enter the well bore—and faster!

Dowell pioneered the well-acidizing field and its engineers have the know-how based on years of experience gained in treating thousands of wells. Ask Dowell to analyze your well—restore its production. Call the nearest Dowell office for a free estimate.

Ask for "More Power to America's Industry"—free color booklet which explains Dowell's thorough Chemical Cleaning Service.

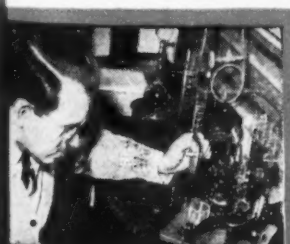
REE SHOWING! Now available—a new minute sound slide film illustrating the sibilities of Dowell Chemical Scale Removal rvice. A Dowell representative will gladly range a special showing at your plant, office or anization meeting. Call or write Dowell today.

DOWELL INCORPORATED, TULSA 3, OKLAHOMA

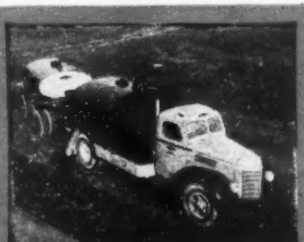
Subsidiary of The Dow Chemical Company

New York • Philadelphia • Baltimore • Buffalo • Cincinnati • Cleveland • Chicago • Detroit
St. Louis • Houston • Kansas City • Wichita • Pittsburgh • Mt. Pleasant, Mich. • Salem, Ill.
Long Beach, Calif., Casper, Wyo.: Dowell Affiliate—International Cementers, Inc.

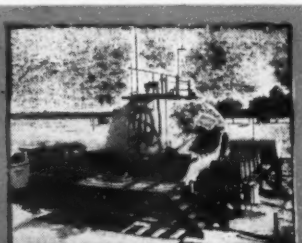
SPECIALISTS IN CHEMICAL CLEANING SERVICE



Dowell's experienced industrial engineers are backed by the complete research and technical facilities of The Dow Chemical Company.



Dowell's equipment is modern and complete—scientifically designed. Treating stations and chemical warehouses conveniently located.

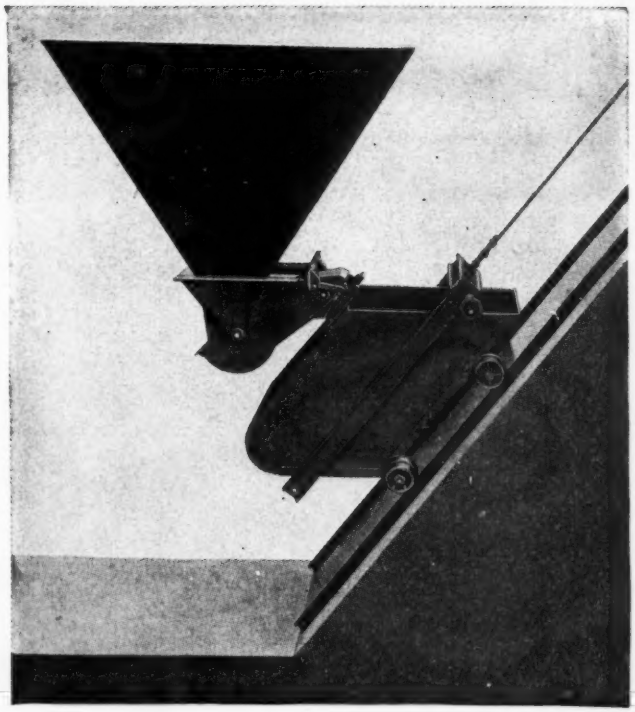


Dowell cleaning solvents are "tailor-made" to fit each job. All ingredients are of the highest quality, chosen for best results in your plant.

DOWELL

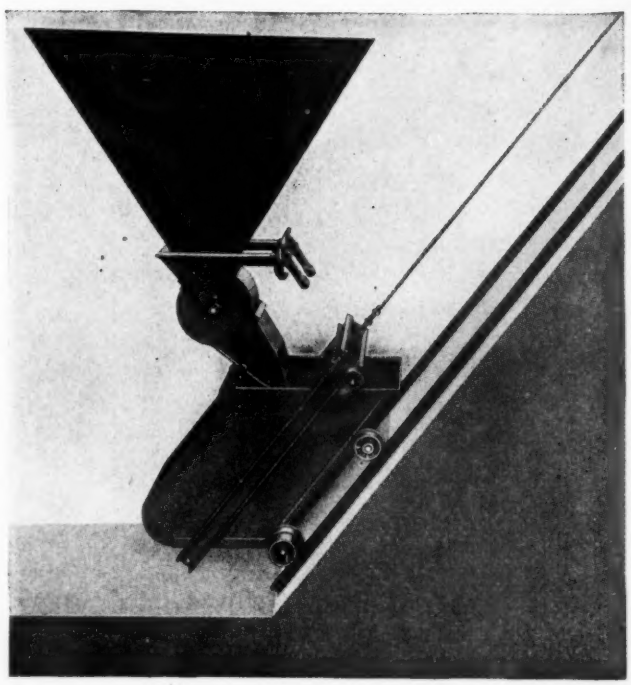
FOR INDUSTRIAL CHEMICAL SERVICE

quiet—
dependable
non-spilling



PLUG FEED SKIP HOIST LOADING GATES

● Conceived and perfected by Bartlett-Snow engineers—originators of the first fully-automatic Skip Hoist—this Plug Feed type loading gate is of sturdy, ingenious design and dependable construction. It operates without friction and consequently encounters little wear. There is no banging or other noise—no jar—no spillage even when the skip bucket is traveling at quite high speeds, and no counterweights or electrical equipment in the pit to require adjustment or other maintenance. Send for Bulletin No. 92. It gives complete details including dimensions of the 11 standard sizes, and other information of much interest to engineers and operating men.



THE C. O. BARTLETT & SNOW CO.

6205 Harvard Avenue, Cleveland 5, Ohio

Engineering and Sales Representatives in the Principal Cities

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COAL HANDLING FOR CENTRAL STATIONS AND INDUSTRIAL BOILER PLANTS

"THRU TRAFFIC" STEAM LANE UPS CONDENSER PERFORMANCE

Tubes in Dual Bank Steam Condensers are symmetrically arranged in two distinct banks, separated by a wide, "thru traffic" lane, with other unobstructed lanes and branches of the central lane, penetrating deep into the tube nests. This distributes the steam so that effective condensing action is contributed by every tube (no stagnant areas) and produces condensate temperatures and pressures equal to those at the steam inlet. The high heat transfer obtained with the modern Dual Bank closely approaches the theoretical "ideal" in overall condenser efficiency; hundreds of utility and industrial power plants know it is soundly engineered, for we pioneered the Dual Bank in 1916. Send for our new 44 page Catalog No. 1461, or may our representative call on you?

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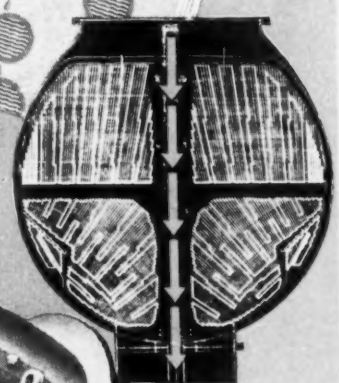
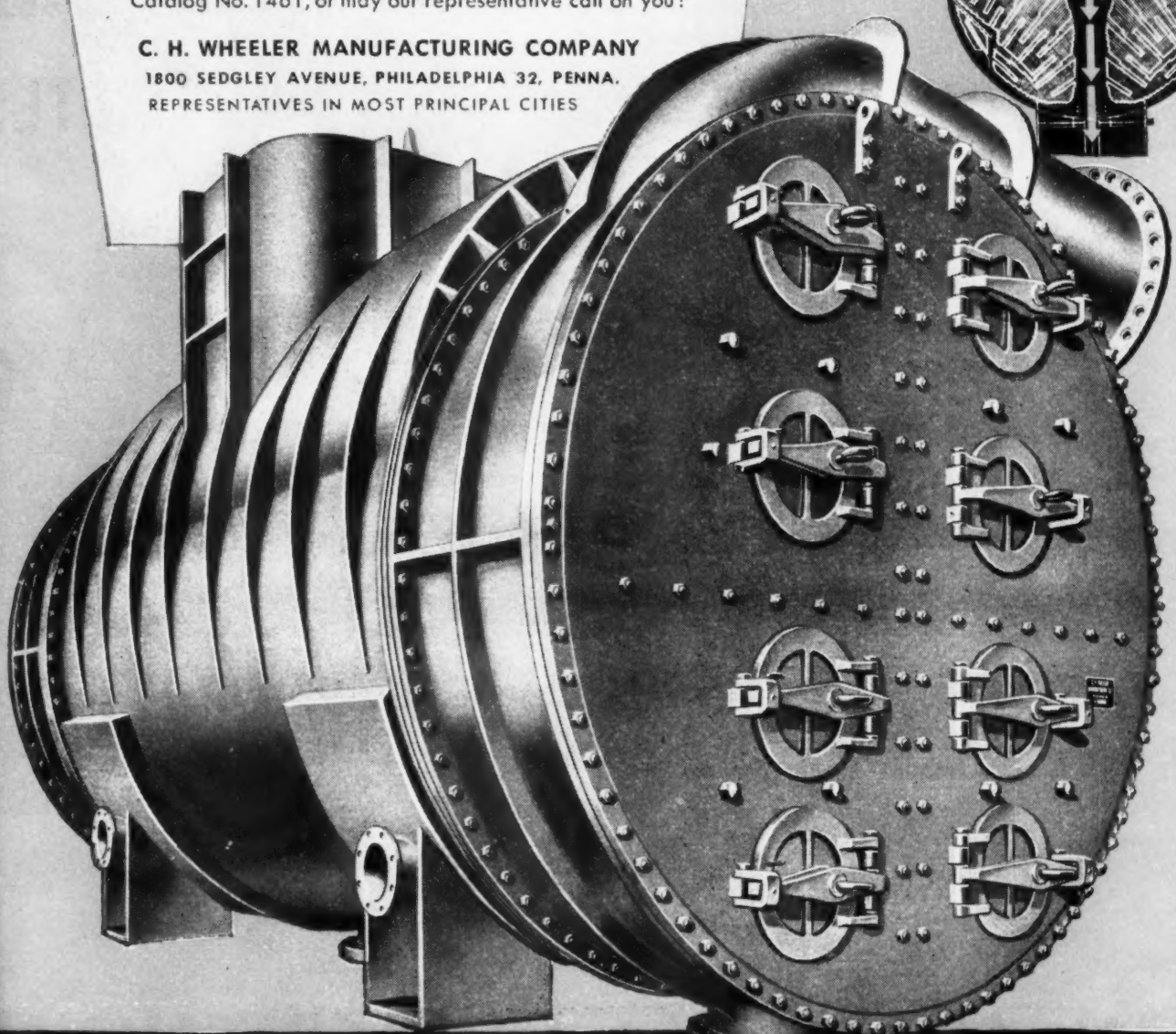
1800 SEDGLEY AVENUE, PHILADELPHIA 32, PENNA.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

NEW CATALOG
No. 1461—44 Pages
WRITE FOR IT

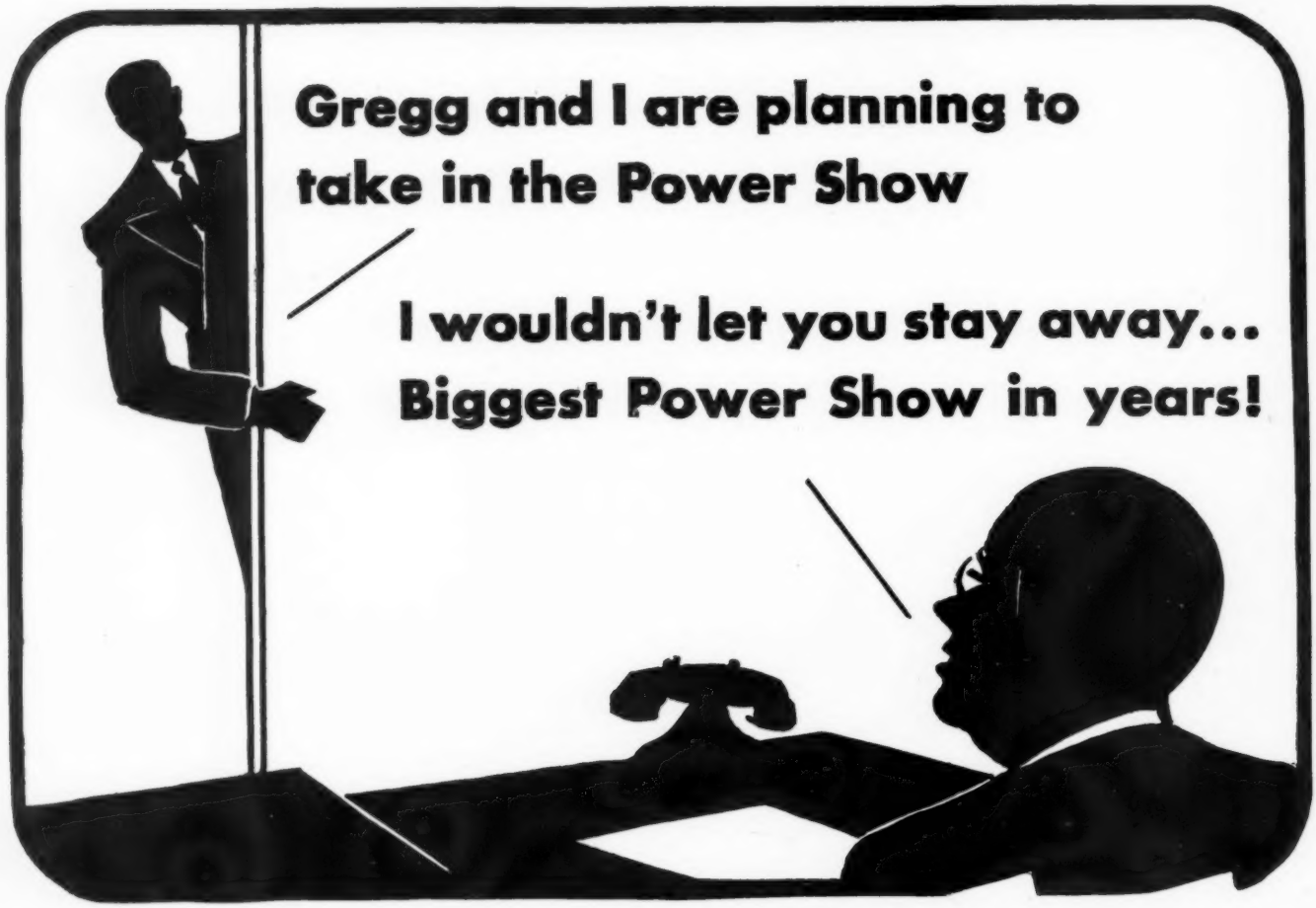
Describes our Surface and Jet Condensers of Low Level and Barometric Types; also Air Ejectors, Circulating and Condensate Pumps, etc; also includes many pages of useful curves, tables, etc.





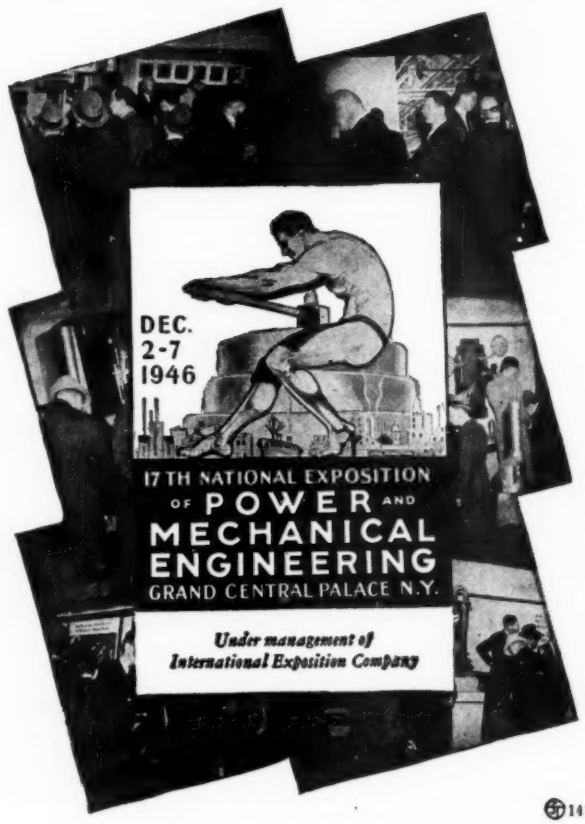
C. H. Wheeler

STEAM CONDENSERS · AIR EJECTORS
COOLING TOWERS · HEAT EXCHANGERS
OF PHILADELPHIA



DON'T MISS IT—don't let your associates miss it. The '46 Power Show is one of the greatest displays of technical advances ever gathered under one roof. Important manufacturers and suppliers will be there — to show you what they're doing and what they're planning. See the new equipment. Consult attending technicians. Bring yourself abreast of advances in the power field—so you can stay ahead in yours.

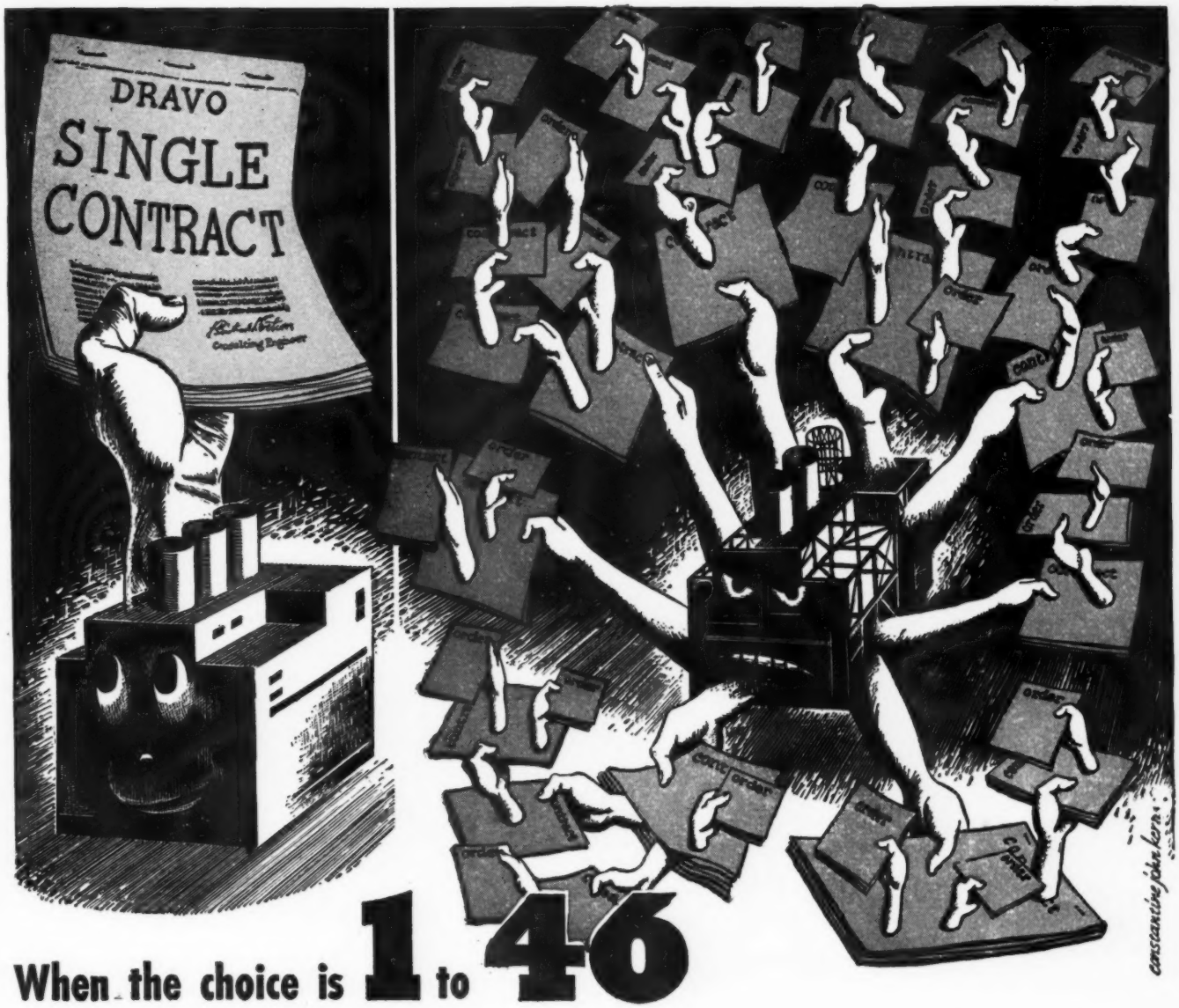
The Power Show is open only to men in the power and mechanical engineering fields. General public is not admitted. Attendance by invitation or registration only. No member of your staff can afford to miss it.



1411

17th NATIONAL POWER SHOW

GRAND CENTRAL PALACE, NEW YORK • DEC. 2-7, 1946



When the choice is 1 to 46

HERE'S HOW IT PAYS OFF!

Power and boiler plant construction involves many separate types of equipment and many specialized building operations. Yet, the efficiency of a power or boiler plant depends upon the ultimate coordination of all these separate elements.

Faced with the alternative of dealing with forty-six separate suppliers, or placing one all-inclusive contract, the recent purchaser of a large boiler plant chose DRAVO single-contract construction and benefited by:

- Reducing expensive supervision and detail
- Centralizing responsibility for coordination of all equipment and labor
- Reducing contractors' extras

With a background of years of experience in contracting, and with a full knowledge of the problems involved in split responsibility, DRAVO employs the *Single-Contract Method* of boiler or power plant construction. Under single-contract responsibility for foundations, super-structure, equipment, piping, and related work, DRAVO has built boiler and power plants for some of the most important industrial, utility, and institutional users.

You'll be interested in Bulletin MD, 504 describing typical DRAVO installations. Power Department, Dravo Corporation, Pittsburgh 22, Pennsylvania

DRAVO CORPORATION

PITTSBURGH
WILMINGTON • PHILADELPHIA
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Power and Boiler Plants • Pumping Stations • Power Plant and Contractor's Equipment • Direct-Fired Heaters
Industrial Heating and Ventilating • Bridge Substructures • Pump Houses and Intakes • Mill Foundations
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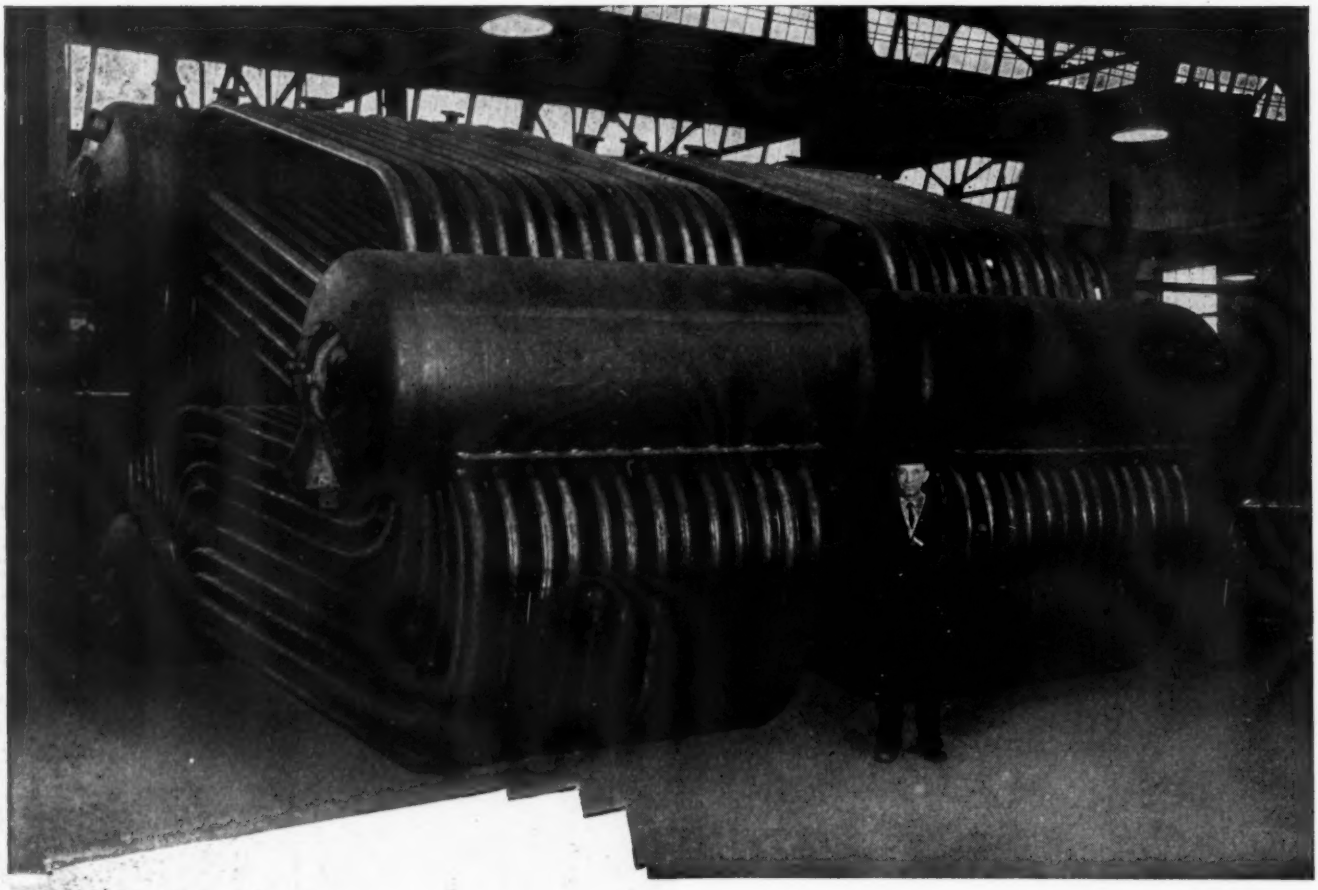
Coal and Ore Bridges • Open Steel Flooring
Crane Cab Coolers • Concrete Aggregates
Inland River Transportation



FOR MAXIMUM EFFICIENCY IN LIMITED SPACE WICKES 3-DRUM LOW HEAD WATER TUBE BOILERS

WICKES 3-Drum Low Head Water Tube Boilers provide an efficient answer to boiler installation problems where floor space and overhead clearance are limited. They are compactly designed, yet incorporate proven principles which assure maximum transfer of furnace heat into boiler energy at all ratings. Unrestricted water circulation. Long-radius tubes are easy to clean, and individual tubes may be removed and replaced without disturbing others in the assembly. Shiplap or monolithic metallic baffles distribute and direct the flow of gases to effect maximum heat transfer to water. Boilers are of welded construction to A.S.M.E. standards, and are available in sizes up to 600 horsepower and operating pressures of 300 P.S.I. Our engineers will be glad to study your boiler problems and suggest an installation of Wickes 3-Drum Low Head Water Tube Boilers or other type Wickes Boilers which will step up your power plant efficiency.

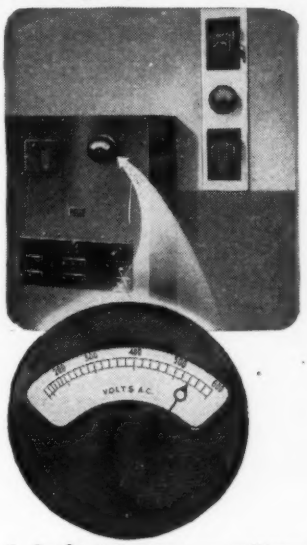
SALES OFFICES: Detroit; Chicago; New York; Milwaukee; Pittsburgh; San Jose; Tulsa; Fort Worth; Mexico City; Saginaw; Boston; Indianapolis; San Francisco; Buenos Aires; Seattle; Los Angeles; Atlanta; Charlotte; Denver; Jacksonville.

Wickes

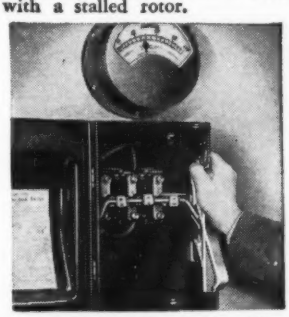
THE WICKES BOILER CO., SAGINAW, MICHIGAN • RECOGNIZED QUALITY SINCE 1854

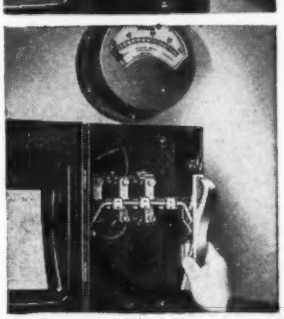
Avoid dangerous arcs. Use *Vacu-Break* safety switches

Laboratory Tests Prove The "Hidden Values" of Safety and Efficiency of *Vacu-Break* Safety Switches, Compared With Ordinary Enclosed Switches.



1 **In the test set-up,** an ordinary enclosed switch and a Vacu-Break Safety Switch are connected in parallel so that either switch can be used to make or break a 30% power factor load of 50 AMPERES, 540 Volts. This power factor approximates the condition prevailing in the case of a motor with a stalled rotor.





3 **The arc is barely visible** when the circuit is ruptured with the VACU-BREAK Safety Switch under the same conditions (but without the precaution of the extension operating handle). Two photos, showing the VACU-BREAK Switch at the instant of opening and closing, differ only in the position of the handle and the operator's hand and the position of the ammeter needle.

2 **An arc of considerable size** and duration, with accompanying flames of dangerous magnitude and intensity is produced when the circuit is ruptured with the ordinary enclosed switch. In this case an extension operating handle was used as an extra precaution. (Keeping the camera open to catch the arc flash produced a phantom picture of the operator's arm as the switch handle was moved to the OFF position to break the circuit.)

DON'T take risks in your plant! Get the positive protection of BullDog VACU-BREAK Safety Switches. Their quick-acting Clampmatic Contacts, "tight as a bolted connection," and the exclusive Bakelite Arcing Chamber that snuffs out dangerous arcs safely and instantaneously, insure long, trouble-free switch life.

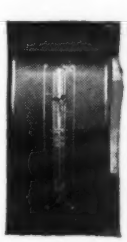
For these authentic test pictures show that even with as small a load as 50 AMPERES, dangerous power arcs can develop on motor circuits under stalled rotor conditions or on welding circuits or similar types of inductive loads.

In such cases, with ordinary enclosed switches a large open arc can jump to a pole of opposite polarity or to the steel switch enclosure causing a dangerous short circuit power arc.

So avoid all such hazards to your personnel and property and minimize pitting and arcing of contacts which lead to eventual break-downs by always specifying —VACU-BREAK—when ordering safety switches.

• • •

BullDog Also Manufactures BUStribution DUCT — Switchboards — Panelboards — Circuit Master Breakers — Industrial Trol-E-Duct for Portable Tools, Cranes, Hoists—Universal Trol-E-Duct for totally flexible lighting.



BULLDOG

ELECTRIC PRODUCTS COMPANY
DETROIT 32, MICHIGAN

In Canada: BullDog Electric Products of Canada, Ltd.; Toronto
Field Offices in All Principal Cities

BIG MAINTENANCE JOB WITH YOUR OIL AND WATER COOLERS?

THE ROSS "CP" DESIGN MAY BE THE ANSWER TO YOUR PROBLEMS

In any cooling system, where two fluids are involved, one fluid will normally foul more than the other. Fouling naturally cuts heat exchange efficiency and creates service interruptions.

The point is that fouling tendencies, most of the time, can't be avoided . . . but shutdown periods for cleaning *can be materially reduced,* and are with Ross "CP" Coolers.

To minimize maintenance, the fluid with the greater fouling tendency is passed through the *inside of the tubes* in the Ross design. For inspection or cleaning, you merely remove the channel cover plates. This gives you quick, easy access to tube interiors *without breaking any pipe connections.* Have you any idea how many hours this takes away from maintenance and adds to production time?

Bulletin 5322 covers details completely.

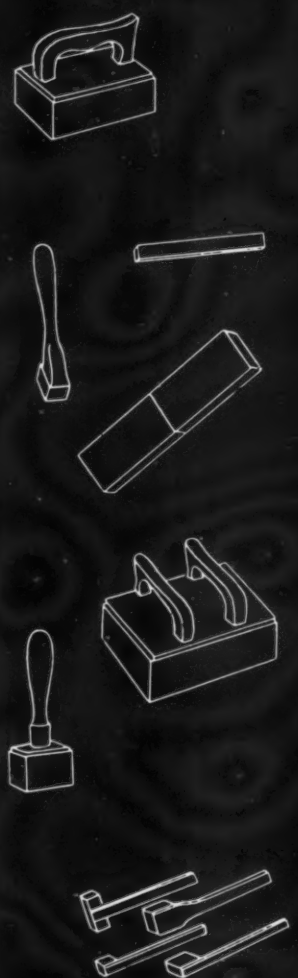
ROSS FIRST IN HEAT EXCHANGERS

ROSS HEATER & MFG. CO., INC. Division of American Radiator & Standard Sanitary Corporation 1415 WEST AVE., BUFFALO 13, N. Y.

ROSS EQUIPMENT IS MANUFACTURED AND SOLD IN CANADA BY HORTON STEEL WORKS, LTD., FORT ERIE, ONT.

KEEP MOTORS IN CONDITION TO RUN AT RATED CAPACITY

with IDEAL Resurfacers



It is easy to restore and maintain the rated capacity of your motors and generators with IDEAL Commutator Resurfacers—stop sparking, eliminate pits, burns and rough spots.

Quick! No dismantling, no reassembling. Job may be done outside of work hours. No production delays.

Easy! Resurfacers are applied by hand and smooth commutator or slip ring while the motor turns under its own power. One man does the job.

Better! Resurfacing is done while armature is running in its own bearings, thus compensating for any eccentricities. The surface is ***actually smoother*** than a lathe-turned job.

No Delay! The IDEAL way is the "Do It Now" way No dismounting, no moving, no shop work.

SIZES AND GRADES FOR ALL CONDITIONS—PROMPT DELIVERY

Other IDEAL Motor Maintenance Equipment: Precision Grinders, Mica Undercutters, Carbon Brush Seaters, Commutator Cleaning Stone, Commutator Saws and Milling Cutters, Slotting Files, Hand-Type Slotter and Scraper

Distributed Through AMERICA'S LEADING WHOLESALERS

IDEAL INDUSTRIES, Inc.

(Successor to Ideal Commutator Dresser Co.)

1025 PARK AVENUE **SYCAMORE, ILLINOIS**

1933

THE HIGH PRESSURE PACKING WITH THE LOW MAINTENANCE COST

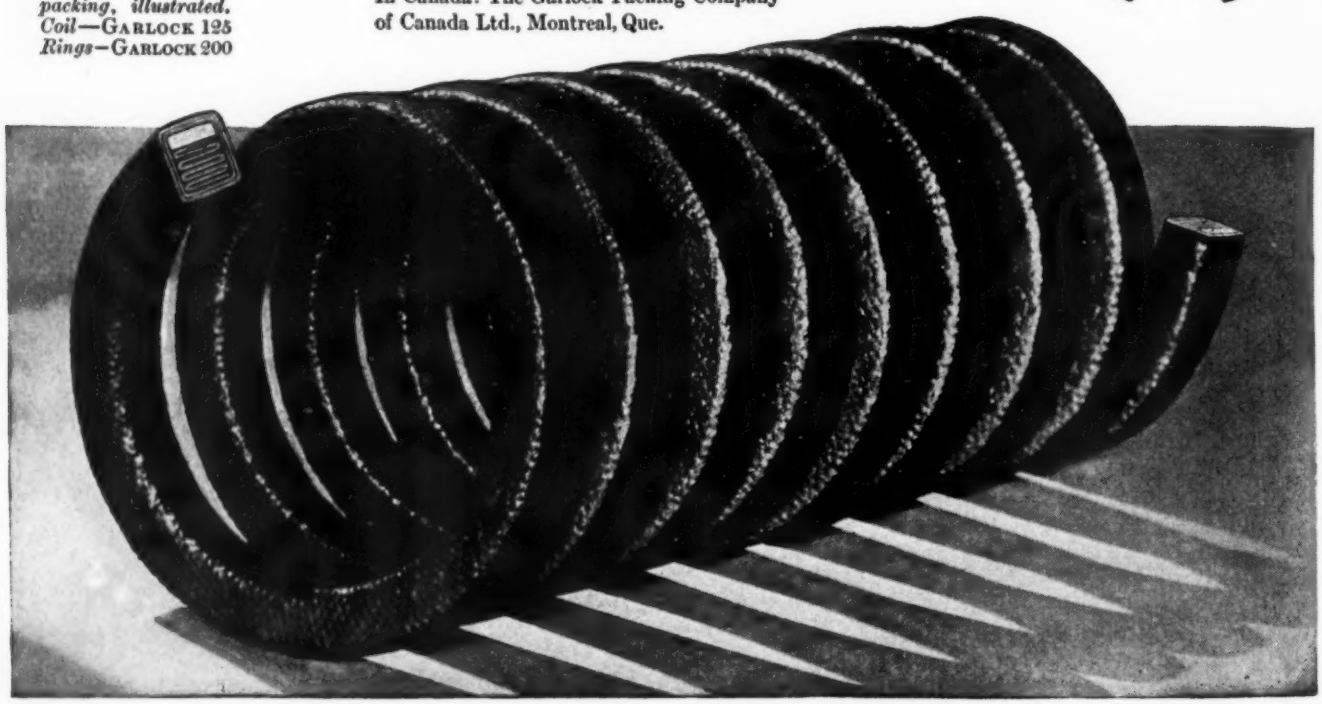
GARLOCK 150

Low in maintenance cost because it gives such *long, dependable* service. Costly shutdowns for frequent repacking are avoided. Man hours and machine hours are saved. Use GARLOCK 150 on piston rods of engines, pumps, compressors, etc., against steam pressures up to 300 lbs.

The Garlock Packing Company, Palmyra, New York

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK 150 *Spiral packing, illustrated. Coil*—GARLOCK 125 *Rings*—GARLOCK 200



SEND FOR THIS BOOK... *it's FREE to You*

YOU'LL want this book! It's the only one of its kind. Prepared by Minneapolis-Honeywell with the assistance of F. W. Hutchinson, nationally recognized authority on panel heating and Honeywell consultant, this manual clearly, concisely, and completely covers the theory and application of automatic radiant panel heating controls. The material in the book is based upon the results of several years of research and tests in homes, commercial buildings and institutions.

Here's a book you will want to study for complete, up-to-the-minute information — then keep for permanent reference. It's a contribution to the heating industry by Honeywell, and is offered free to you. Mail the coupon today.

MINNEAPOLIS
Honeywell
CONTROL SYSTEMS

MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
2607 Fourth Avenue South, Minneapolis 8, Minn.

Please send my free copy of "Automatic Control of Radiant Panel Heating"

Name_____

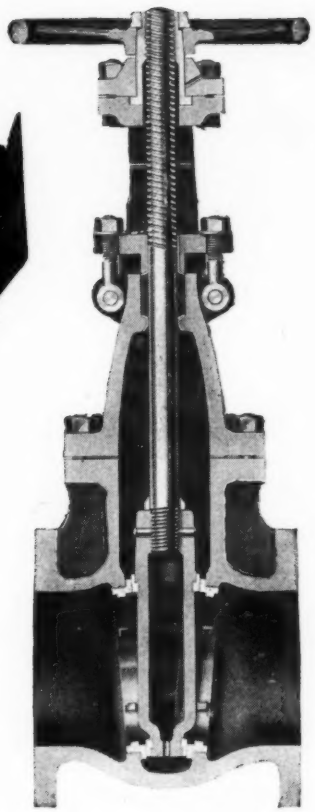
Address_____

City_____ State_____

Every feature you want in an

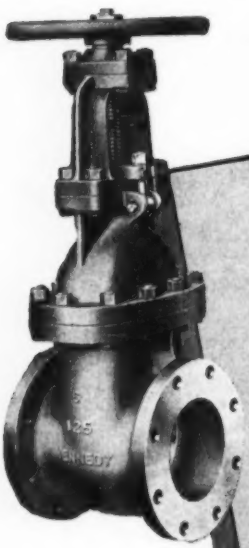
IRON BODY WEDGE GATE VALVE

is in this KENNEDY DESIGN



Whether you examine this Kennedy Standard Iron Body Wedge Gate Valve for basic features that assure ample strength, long service and trouble-free operation, or for refinements that provide extra conveniences and ease of assembly, operation and maintenance, you will find a design that gives you extra values . . . at no extra cost.

Engineers who have tried these valves have become so enthusiastic about their many superiorities that plants all over the country have standardized on them for iron-body wedge gate valve services. These superiorities are fully described in the 240-page Kennedy Catalog, which also shows the entire Kennedy line of bronze and iron body gate, globe, angle and check valves, malleable iron and bronze screwed pipe fittings, and cast iron flanged fittings and flanges. Be sure to write for your copy today . . . you will find it a valuable help in the selection of valves and pipe fittings for your requirements.



Buy From Our Distributor

YOU WANT THESE VALVE FEATURES
. . . you'll find them in this KENNEDY design

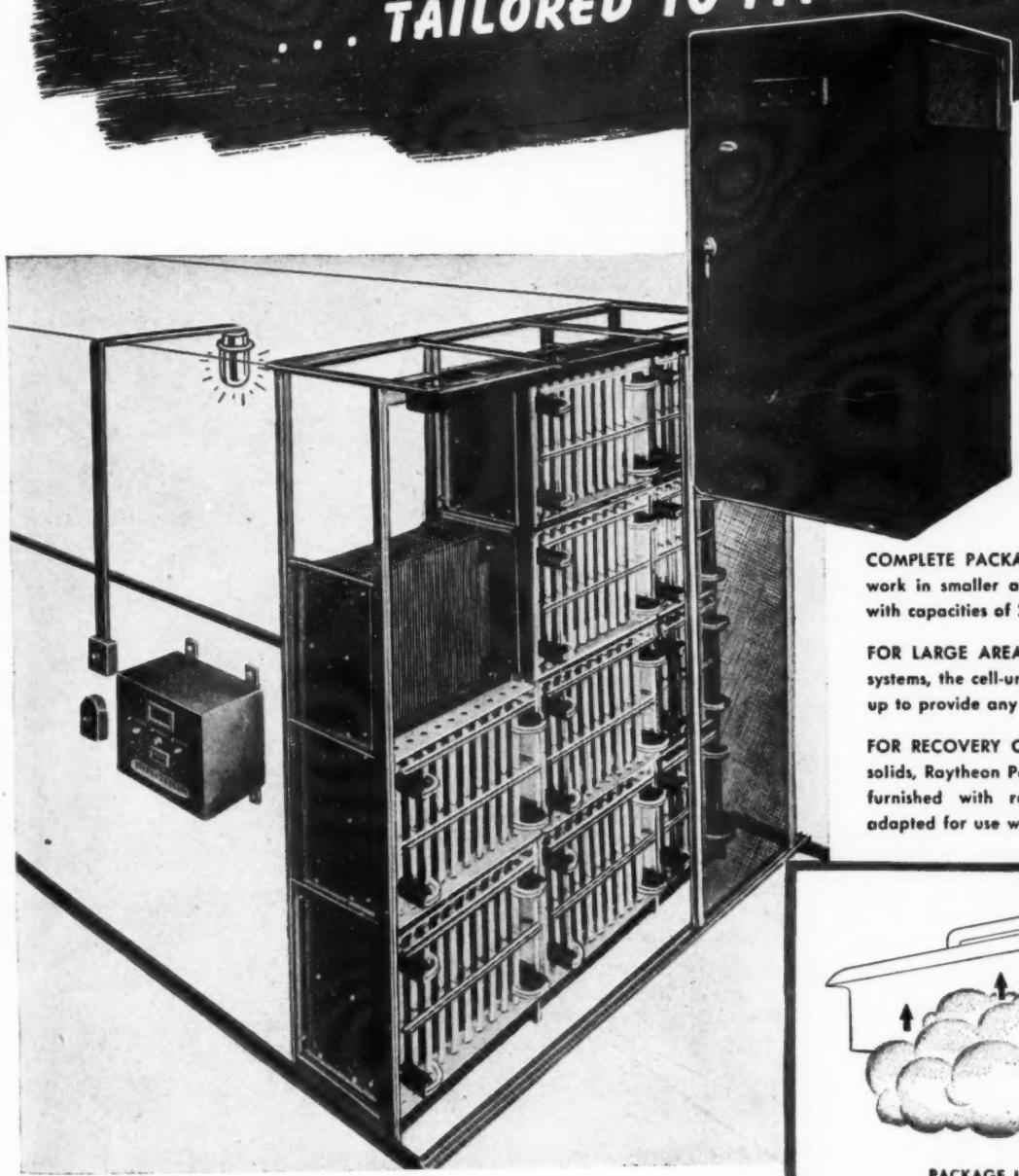
1. **Generous Strength . . .** Body and bonnet are of high-grade dense metal with ample thickness and rounded fillets. Stem has large diameter and extra large number of contact threads.
2. **Easy Operation . . .** Stem and stem contact surfaces are accurately threaded. Deep stuffing boxes permit tightness without undue pressure on packing. Large handwheel gives firm, comfortable grip.
3. **Lasting Tightness . . .** Discs and seats seat accurately, and their sturdy design resists distortion and has special provisions for take-up of wear.
4. **Long Life . . .** Many Kennedy valves have been in daily use a quarter century and more.
5. **Convenient Repacking . . .** Glands and packing are easily accessible.
6. **Economical Maintenance . . .** Long wear built into all parts, and adjustments or other attention are seldom required.

THE KENNEDY VALVE MFG. CO.
Elmira, New York

KV-481

KENNEDY *valves - pipe fittings - fire hydrants*

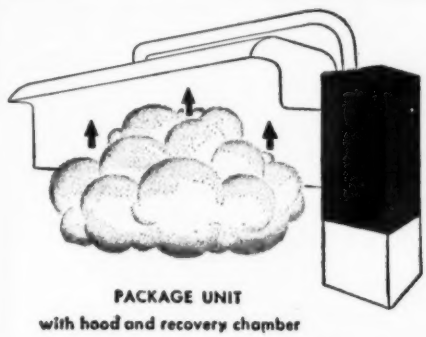
RAYTHEON ELECTRONIC AIR CLEANING . . . TAILORED TO FIT YOUR NEEDS



COMPLETE PACKAGE UNITS can be put right to work in smaller areas. Available in several sizes, with capacities of 200 to 2250 c.f.m.

FOR LARGE AREAS or installation in existing duct systems, the cell-unit type Precipitator can be built up to provide any required capacity.

FOR RECOVERY OF FLUIDS and certain types of solids, Raytheon Package Type Precipitators can be furnished with recovery chamber, and readily adapted for use with any type hood.



PACKAGE UNIT
with hood and recovery chamber

Before you invest in air cleaning equipment, consider the extra advantages offered by RAYTHEON.

Built in any capacity from 200 c.f.m. up, RAYTHEON Precipitators supply electronically-cleaned air for any area regardless of size. These new, high-efficiency units remove virtually all airborne dust, smoke, pollens, oil mist, etc. down to particles as fine as 1/250,000 of an inch.*

Wherever clean air pays dividends . . . as in processing, high-precision fabricating, measuring, testing . . . there's a RAYTHEON Precipitator of the exact size and type to fit your needs.

Write today for Bulletin DL-P-503 and 505

*According to Bureau of Standards discoloration tests, the Precipitator is more than four times as efficient as any mechanical filter.

RAYTHEON

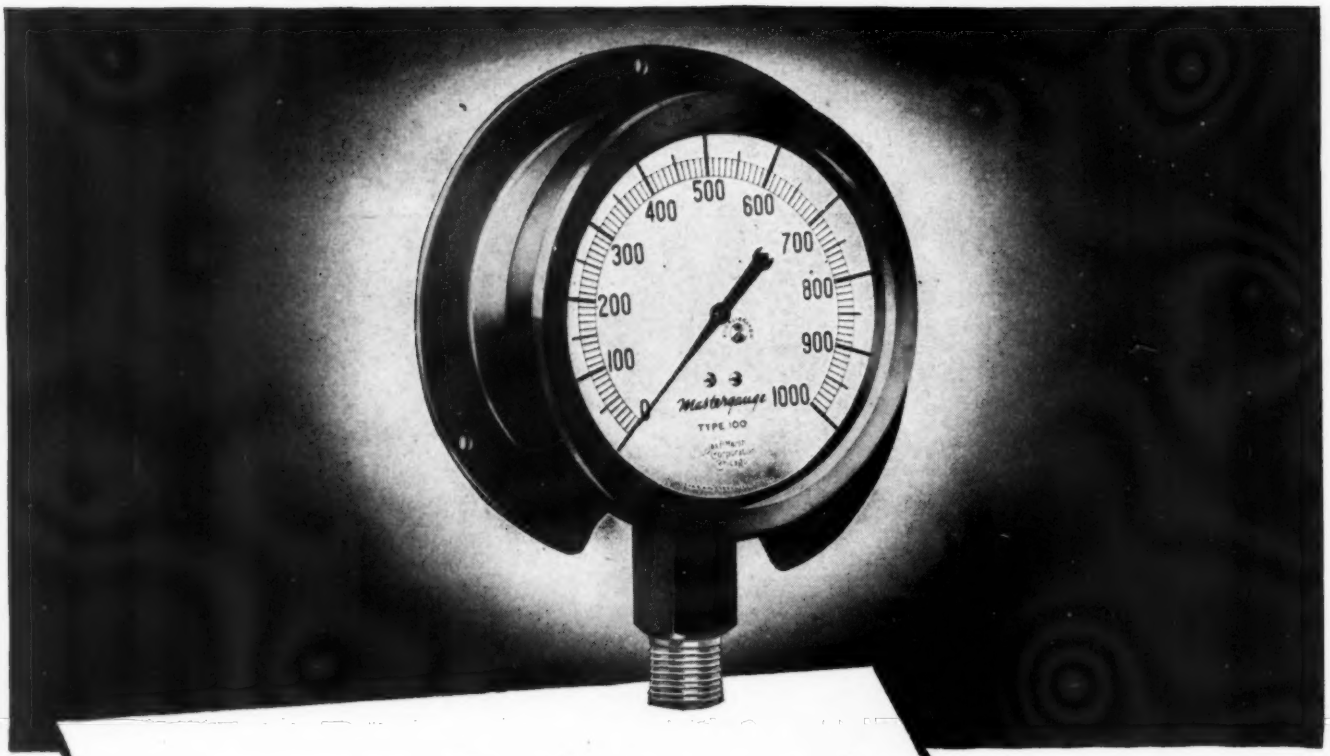
Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Industrial Electronics Division
Waltham 54, Massachusetts

Builders of Raytherm Dielectric Heaters for every industrial application. Synchronous Controls for Resistance Welding and other Electronic Products for Industry

Sales Offices: Atlanta • Boston • Chicago • Cleveland • Louisville • New York



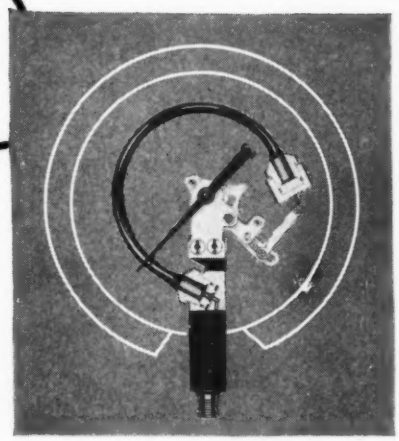
Modern Design . . . .

with old time ruggedness

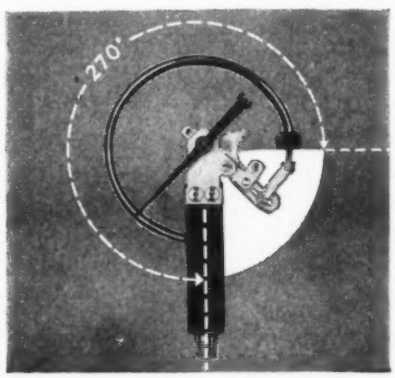
THERE is a wrong way and a right way to design equipment. The wrong way seeks the means of skimping materials and cutting costs. The right way searches for every means of improving performance and lengthening service life. This is the Marsh way.

All the "know-how" acquired in more than three-quarters of a century of instrument making is reflected in the design of Marsh Gauges. A few outstanding elements are illustrated here—the Marsh unit construction; the 270° bourdon tube; the "Recalibrator". And you will find this design know-how carries into every detail of Marsh Gauges from socket to dial.

Marsh design means attractive cases, clear legible dials, ingenious, practical working parts. As executed in quality materials, it means lasting accuracy.



The working unit of Marsh Gauges—bourdon tube, dial, movement, and pointer—are assembled on the socket or bottom piece, the case merely serving as an enclosure as shown by the white lines. As a result, external shocks are not transmitted to vital parts—one of many reasons for lasting accuracy.



Even graduations make Marsh dials highly legible. These even graduations are made possible by the 270° bourdon tube—a design that brings the travel and direction of tube movement into such relationship to the linkage that each unit of pressure causes exactly proportional pointer movement.

JAS. P. MARSH CORPORATION
2075 Southport Avenue, Chicago 14, Illinois
Export Dept.: 155 E. 44th St., New York 17, N. Y.

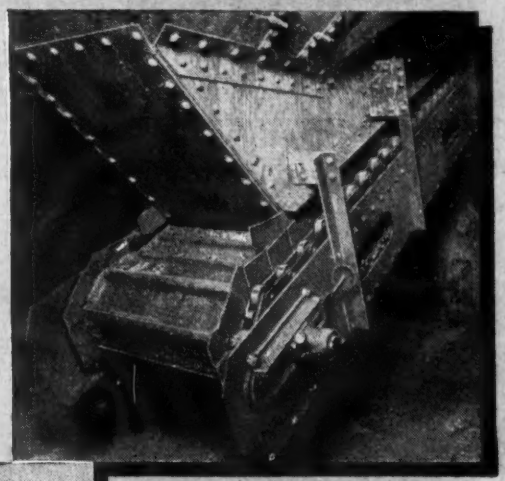
No story of Marsh design would be complete without the "Recalibrator" — best way ever devised to correct a gauge that has been knocked out of adjustment.

MARSH GAUGES

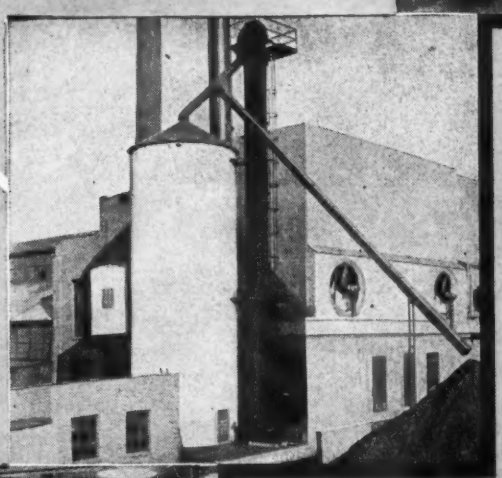
"THE STANDARD OF ACCURACY"

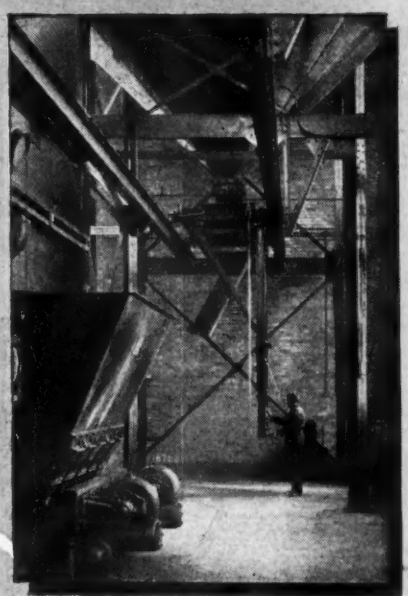
FOR LOW COST PER TON HANDLED

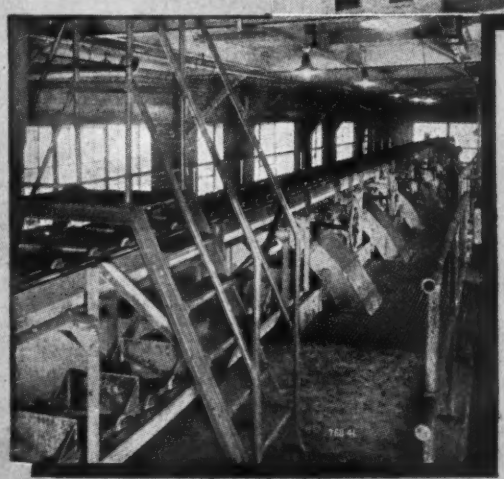
Use Jeffrey



Belt Idlers
Bin Valves
Bucket Elevators
Car Pullers
Chutes
Coal Crushers
Conveyors—Belt, Spiral, Pivoted Bucket, V Bucket, Chain, Scraper
Feeders—Apron, Electric Vibrating, Plate
Skip Hoists
Silo Storage Systems
Track Hoppers
Weigh Larries







Power Plant Equipment

THE JEFFREY MANUFACTURING COMPANY

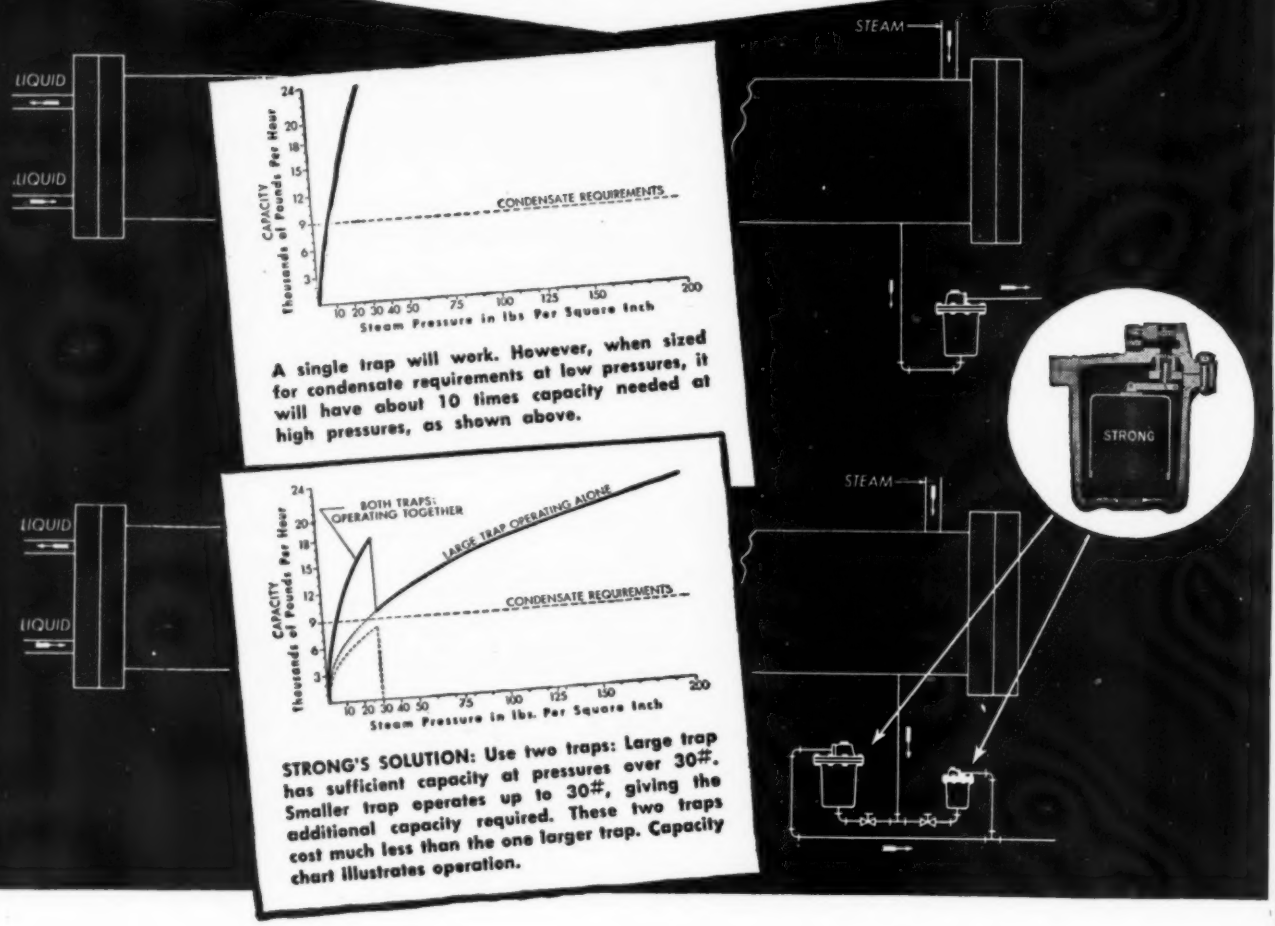
ESTABLISHED 1877

932-99 North Fourth St., Columbus 16, Ohio

Baltimore 1 Buffalo 2 Cleveland 13 Huntington 19 Milwaukee 11 Pittsburgh 22
Birmingham 3 Chicago 1 Denver 2 Houston 5 New York 7 St. Louis 3
Boston 16 Cincinnati 2 Detroit 32 Philadelphia 3 Salt Lake City 9
Scranton 3

WHERE 2 TRAPS COST LESS THAN 1

PROBLEM: Extreme pressure variation.
EXAMPLE: Heat exchanger with pressures from 10# to 200#; condensate 9,000# per hour.



A single trap will work. However, when sized for condensate requirements at low pressures, it will have about 10 times capacity needed at high pressures, as shown above.

STRONG'S SOLUTION: Use two traps: Large trap has sufficient capacity at pressures over 30#. Smaller trap operates up to 30#, giving the additional capacity required. These two traps cost much less than the one larger trap. Capacity chart illustrates operation.

"KNOW-HOW" TO DO MEANS "KNOW-HOW" TO SAVE!

There are always different ways to apply steam traps to a given problem.

Some are better than others, and reduce steam costs or increase production or insure product quality. Here efficiency means economy.

Occasionally, less expensive hookups can give the same results as costly equipment. Here ingenuity, thorough knowledge and a complete line of steam specialties give a practical answer at desirable savings.

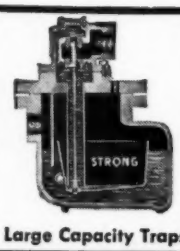
In either case, the "know-how" of Strong engineers is at your service. Their recommendations are backed both by long experience and the complete Strong line, including open and inverted bucket, closed float, float-and-thermostatic (blast) traps, etc.—forged, fabricated (welded) cast and semi-steel construction. Send your problems to Strong, Carlisle & Hammond Company, Cleveland 13, Ohio. No obligation, of course.

STRONG, CARLISLE & HAMMOND COMPANY
Cleveland 13, Ohio

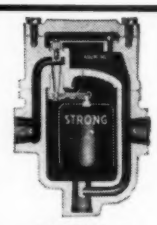
REG. TRADE MARK

OTHER **STRONG** STEAM SPECIALTIES

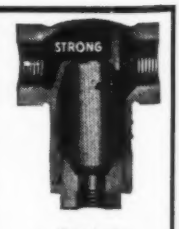
ANUM-METL Reg Trade Mark



Large Capacity Traps



Blast Trap



Strainer

Thermoid – For Progress in Industry

The old-fashioned hand gun was a great advance over the oil can and grease paddle. But it was still slow and lubricant-penetration was uncertain.

Just pit the antique method above against this modern, powerful portable greasing unit for servicing all types of automotive and construction equipment on the job. The compressor here delivers pressures up to 200 lbs. which may be boosted on the hydraulic side to as high as 10,000 lbs. per square inch! Thermoid wire braid hydraulic hose carries this load with ease.

HELPING the planners of tomorrow's products and methods is just one of Thermoid's services to industry. Without the development of a hose capable of extremely high pressures, the above pictured greasing unit would still be an "inventor's dream." The production of Industrial grease and hydraulic control hose is the answer to many difficult problems. There's an answer waiting at Thermoid for your special hose problems, too.

Get in touch with your local Thermoid Jobber or direct factory representative. 60 years of research and industrial rubber know-how are at your beck and call for problems relating to all kinds of hose, belting and friction materials.

THE THERMOID LINE INCLUDES: Transmission Belting • F.H.P. and Multiple V-Belts and Drives • Conveyor Belting • Elevator Belting • Wrapped and Molded Hose • Sheet Packings • Industrial Brake Linings and Friction Products.

Thermoid Rubber

DIVISION OF THERMOID COMPANY

308 Whitehead Road, Trenton 6, New Jersey

Contributor to Industrial Advancement Since 1880

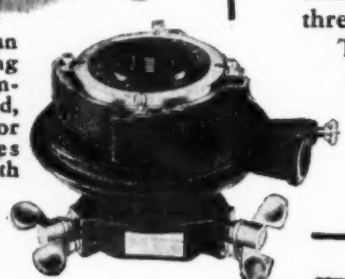
First Flight BY THE WRIGHTS

. . . in the early days of TOLEDO Leadership in Pipe Tools!

It was a dreary December day in 1903 when the Wright Brothers made their momentous flight over the sand flats of North Carolina . . . *the world's first successful airplane flight!*

In the 12 H. P. biplane weighing a total of 750 lbs., Wright stayed in the air 12 seconds. Three more flights were made the same day, the fourth of which covered 852 feet in 59 seconds attaining a speed of 30 M. P. H. Compare this with the advancement made in aviation to today's jet propelled planes traveling 660 M. P. H.

These were the days, too, when TOLEDO Pipe Tools were first being produced. And in their field, these tools soon demonstrated outstanding merit . . . expanding from four basic threaders introduced in 1902 to the wide range of TOLEDO-Engineered Pipe Tools and equipment of today. The Toledo Pipe Threading Machine Company, Toledo, Ohio. New York Office, No. 2 Rector Street Bldg.



Toledo SIMPACT—an example of outstanding design and performance! A self-contained, adjustable threader for 1" to 2" pipe. Sizes changed instantly with one set high speed steel dies. Accurate, dependable.

"TOLEDO"

TOLEDO

PRECISION PIPE TOOLS

This *one* basic blueprint* solves *all* problems in coal-and-ash-handling

Here's a *complete* plan for a system that will take care of your coal-and-ash-handling problems, whether your plant is large or small. This *typical*, basic G-W System can be adapted, with but slight modifications, to any plant's requirements.

*G-W SYSTEM NOW BEING BUILT FOR A 2,000 kw. UNIT POWER PLANT

1. Coal passes through *Grating, Hopper* and *Control Gate* to feeder pans.
2. *Apron Feeder* draws coal from hopper, conveys it at uniform rate to crusher.
3. *Crusher* delivers stoker-sized coal to elevator boot.
4. *Bucket Elevator* discharges coal to surge hopper.
5. *Surge Hopper Control Unit* assures constant supply to scale.
6. *Scale* automatically weighs, records and discharges to shuttle belt conveyor.
7. *Shuttle Belt Conveyor* serves several bins from central weighing point.
8. *Storage Bins* have coal level control.
9. *Control Gate* and *Spout* to stoker.
10. *Ash Unloading Gate.*
11. *Ash Cart* manually operated through tunnel.
12. *Ash Cart* electrically operated for ash disposal.

COAL IN . . . ASHES OUT

G-W will do the complete job. From start to finish G-W shoulders full responsibility for all details of design, manufacture, and erection. You save the time and money usually spent in dealing with sub-contractors. Two-way assurance that G-W will install the coal-and-ash-handling equipment that's best for your plant: hundreds of satisfied G-W equipment users; more than 130 years' experience in designing material-handling equipment for all types of industries. Gifford-Wood Co., 420 Lexington Ave., New York 17, N. Y.; 565 W. Washington St., Chicago 6, Ill.—Factory: Hudson, N. Y.

GIFFORD-WOOD

G-W HANDLES IT . . .
faster • easier • cheaper

SINCE 1814

1723

THE CABLE THAT GIVES YOU

More Service Per Foot

Installment-plan buying won't give you the most for your money in wire and cable. A low price per foot may look attractive, but if you have to repeat the purchase again and again because it failed to stand up under severe operating conditions you are pyramiding the cost and piling a lot of installation expense on top of it. Add service interruptions, lost production and shutdown possibilities to that and you have something worth thinking about.

If you want to keep your circuits functioning on an economical basis check up on how long they are lasting around boilers, furnaces, kilns, soaking pits, and in power plants, steam tunnels, pump rooms or other hot-spots. Find out how often they have to be replaced and plan to re-wire the maintenance-boosters with *permanently insulated* Rockbestos A.V.C. wires, cables, cords that are designed to operate *continuously* at 230°F., without baking brittle, cracking or flowing.

For wire and cable that gives you *more service per foot* specify Rockbestos-developed National Electrical Code types in Rockbestos A.V.C. and All-Asbestos constructions. 125 different types to select from in 300 to 5000 volt ratings for power, lighting and control circuits. For recommendations or a catalog write to:

ROCKBESTOS PRODUCTS CORPORATION
164 Nicoll St., New Haven 4, Conn.

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

The cable illustrated above, Type AVA Rockbestos A. V. C. Power Cable, is one of 125 different permanently insulated wires, cables and cords designed by Rockbestos to meet severe or unusual operating conditions.

NEW YORK BUFFALO CLEVELAND CHICAGO PITTSBURGH ST. LOUIS LOS ANGELES SAN FRANCISCO SEATTLE PORTLAND, ORE.

To obtain

MAXIMUM DISTILLED WATER with MINIMUM STEAM

use...

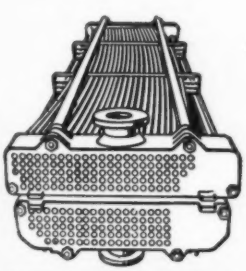
A MULTIPLE EFFECT G-R EVAPORATOR SYSTEM

ONLY G-R BUILDS THIS WIDE VARIETY OF HEAT TRANSFER APPARATUS

SHELL and BARE TUBE
Heaters, Coolers, Condensers, Heat Exchangers

G-FIN
Longitudinal-finned elements for greater heat conductivity

K-FIN
Helical-finned elements for vapors and gases



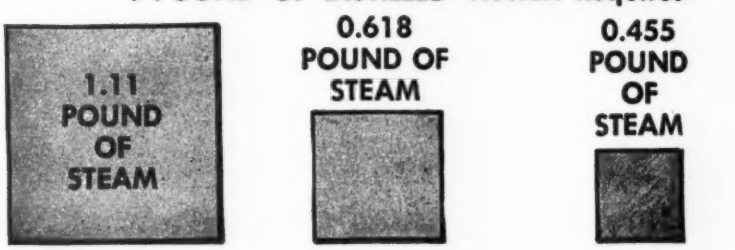
BENTUBE EVAPORATOR
Scale-shedding Elements

TUBEFLO SECTIONS
Non-clogging design for residuum and other dirty fluids

The amount of steam required to produce a pound of pure distilled water — by single effect and multiple effect evaporators — is diagrammatically shown below.

The greater thermal efficiency of a multiple effect system produces more distillate per pound of steam — a great advantage in plants requiring a large percentage of boiler feed make up with a minimum of available steam.

1 POUND OF DISTILLED WATER Requires



IN 1 - EFFECT EVAPORATOR PLANT

IN 2 - EFFECT EVAPORATOR PLANT

IN 3 - EFFECT EVAPORATOR PLANT

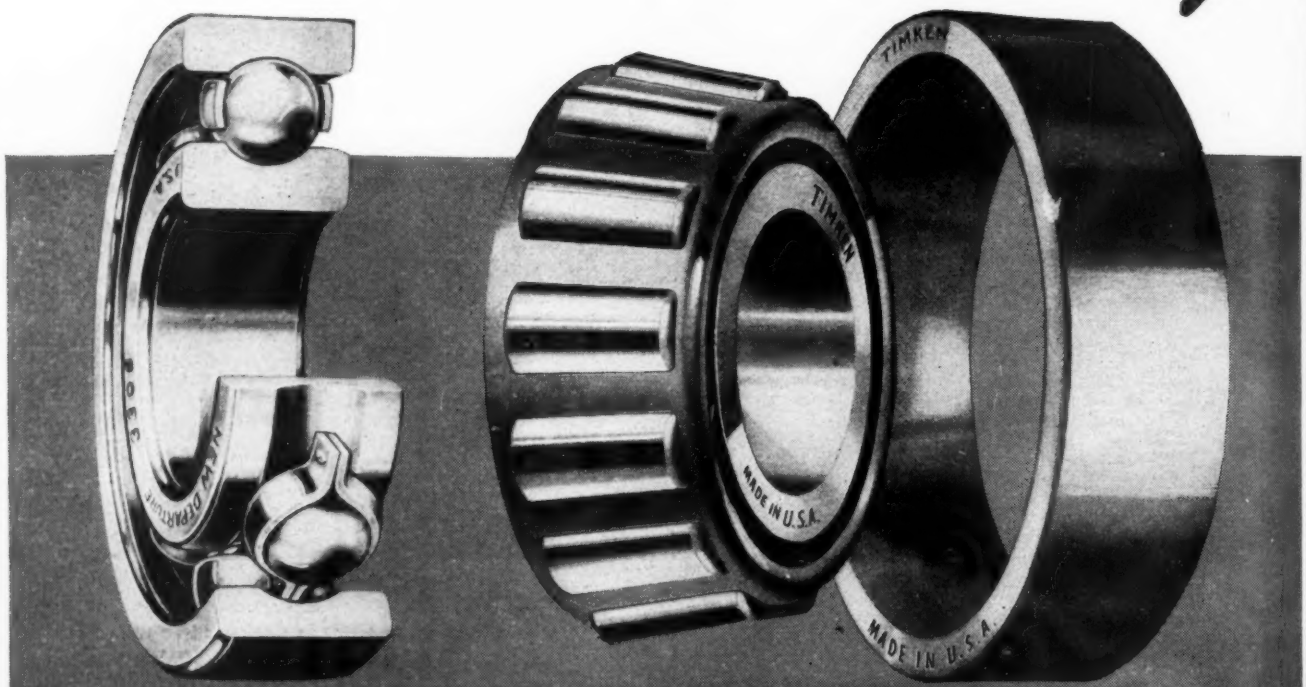
A more complete explanation of multiple effect evaporator systems, and other factors involved in the decision of the most economical method of producing pure distilled water or vapor for individual plant requirements — are fully discussed in Bulletin 364 which will be sent without obligation on request.

THE GRISCOM-RUSSELL CO.
285 Madison Ave. New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

Anti-Friction Greases
FOR
Anti-Friction Bearings



SINCLAIR BEARING GREASE AF
MINIMIZES FRICTION LOAD ON MACHINERY

Anti-friction bearings not only act to minimize friction load on machinery; they serve long periods without lubrication and maintenance attention . . . *if the correct lubricant is used.*

For maximum serviceability of bearing and lubricant, special anti-friction bearing greases are required. Such a grease must be smooth...must keep a film of lubricant on balls or rollers and races... must not bleed or separate...must not thin out nor thicken in use.

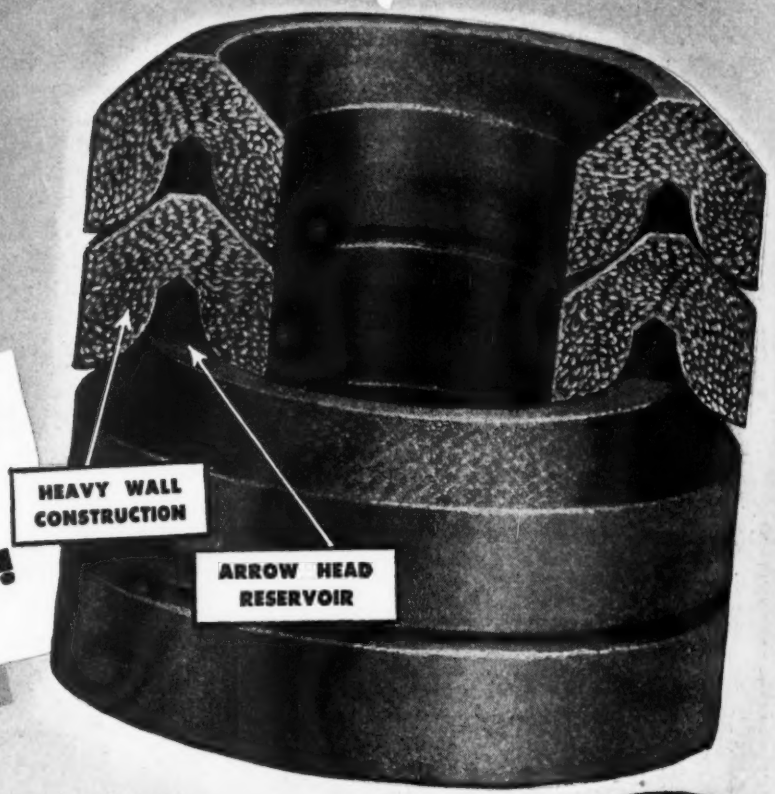
Highly developed manufacturing techniques and high quality oils of correct body are used in making Sinclair BEARING GREASE AF. All ingredients are carefully selected and controlled to produce a lubricant of long endurance and stability through extended periods of continuous operation. Ask our engineers for specific advice.

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N.Y.

PALMETTO *Pyramid*

the most talked about "VEE" type molded packing



...talked about because
IT HAS EVERYTHING!

Packing users all over the country are talking about the new packing that *seals completely* with simple finger-tightening . . . that is *entirely automatic* in performance . . . that *stands up longer* under grueling service!

Here are some of the many features that make PALMETTO PYRAMID worth talking about—*and installing!* Its sealing action is effected by internal pressure...the greater the internal pressure —the tighter the seal. A unique "arrowhead reservoir", which stores and distributes the lubricant . . . plus the unusually heavy wall construction . . . reduces wear and adds to service life.

PALMETTO PYRAMID gives exceptional performance on reciprocating as well as rotating equipment . . . is recommended *without reservation* for a wide variety of services and conditions.

If you are operating hydraulic or pneumatic equipment—under tough conditions—it will pay you to investigate the PALMETTO line of Molded Packings. There's plenty of talk about their performance — because longer, more efficient, more economical service *always* gets talked about! Write *now* for full information on these PALMETTO Molded Packings: PALMETTO *PYRAMID*, PALMETTO *"U-RING"*, PALMETTO *KUP* and PALMETTO *FLANGE*.

PALMETTO *"U-RING"*

PALMETTO *KUP*

PALMETTO *FLANGE*

"It pays to know your PALMETTO Distributor!"

This coupon is for your convenience. Mail it today!

GT-1587

GREENE, TWEED & CO.
New York 66, N.Y.

☐ Send literature on PALMETTO Pyramid and other Molded Packings.

☐ Send PALMETTO representative to discuss packings.

Name .....

Company .....

Street .....

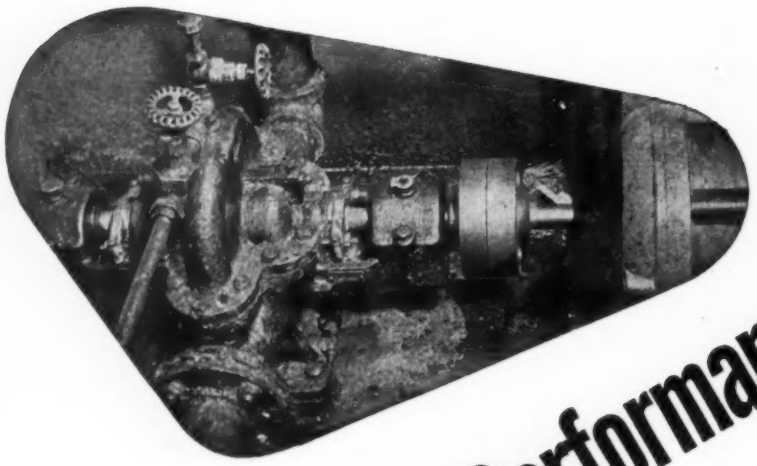
City ..... *State* .....

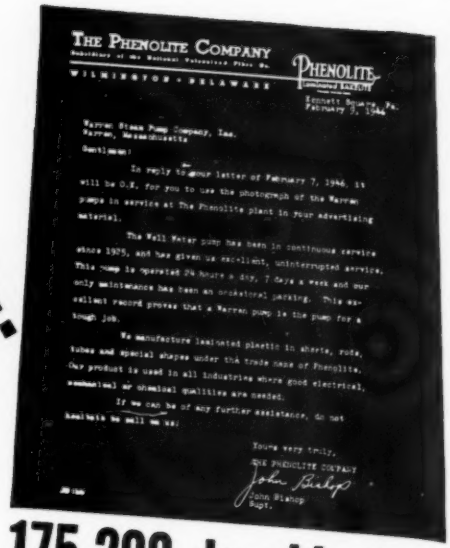
GREENE, TWEED & CO.

Manufacturers of PALMETTO Packings

BRONX BLVD. AT 238th ST. NEW YORK 66, N.Y.

Plants at New York, N. Y. and North Wales, Pa.





THE PHENOLITE COMPANY
Subsidiary of the National Petroleum Plan Co.
WILMINGTON • DELAWARE
PHENOLITE
Laminated Bakelite
Kennett Square, Pa.
February 7, 1946

Warren Steam Pump Company, Inc.
Warren, Massachusetts

Gentlemen:

In reply to your letter of February 7, 1946, it will be O.K. for you to use the photograph of the Warren pumps in service at The Phenolite plant in your advertising material.

The Well Water pump has been in continuous service since 1925, and has given us excellent, uninterrupted service. This pump is operated 24 hours a day, 7 days a week and our only maintenance has been an occasional packing. This excellent record proves that a Warren pump is the pump for a tough job.

We manufacture laminated plastic in sheets, rods, tubes and special shapes under the trade name of Phenolite. Our product is used in all industries where good electrical, mechanical or chemical qualities are needed.

If we can be of any further assistance, do not hesitate to call on us.

Yours very truly,
THE PHENOLITE COMPANY
John Bishop
John Bishop
Supt.

Can you top this Performance?

P4

175,200 trouble-free pumping hours

This is the record set up by a Warren Single Stage, Double Suction, Centrifugal Pump at the plant of The Phenolite Company, Kennett Square, Pa. This is based upon twenty years of continuous 24-hours-a-day, 7-days-a-week service. The pump, of necessity, is located in a pit 10 feet in depth, with six inches of water in the bottom and plenty of moisture on the side-walls. A tough job, requiring a tough pump . . . and yet over this long period the user says the only maintenance has been an occasional packing! Other Warren Pumps at Phenolite, and elsewhere, are performing equally well.

If your pumping problem involves General Water Service, Boiler Feed, Paper Mill Services, Process, Dewatering, Condensate Return, Oil Handling, Hydraulic Pressures . . . or other services, your inquiry will receive prompt attention.

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASS.

Atlanta Boston Chicago Cleveland Detroit Houston Hartford
Indianapolis Los Angeles Minneapolis New Orleans New York
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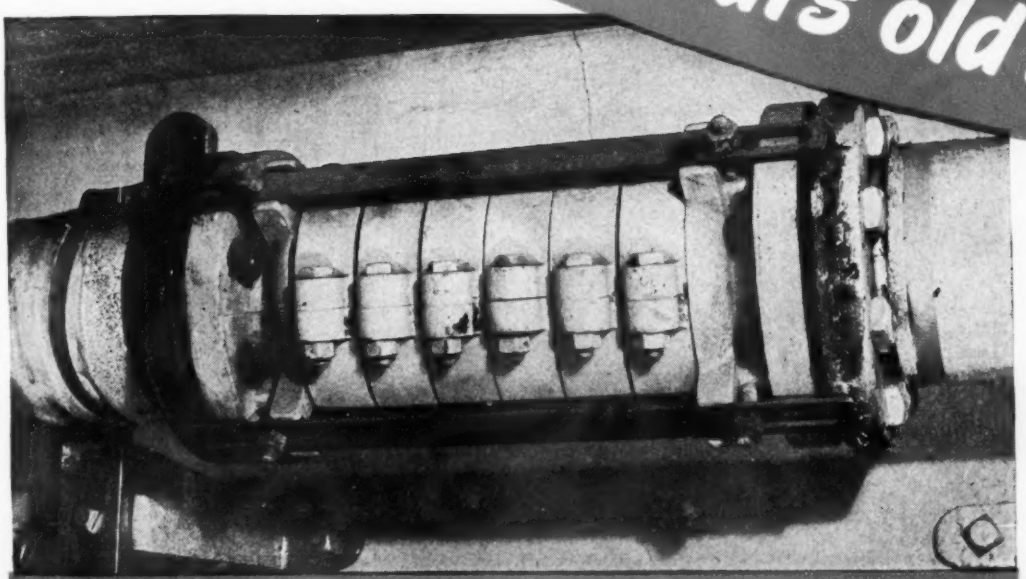
For greater dependability, longer life, lower maintenance

WARREN PUMPS



but more than just a memory

ZALLEA self-equalizing Corrugated Expansion Joint installed on 100 lb. steam line at Norristown State Hospital, Norristown, Pa. In constant service since 1933.

CONVERTED into years, that takes us back to 1933. That's the year the New York Giants won the World Series . . . the Chicago World's Fair opened . . . Wiley Post flew the *Winnie Mae* around the world. During that year this ZALLEA Corrugated Expansion Joint was installed—and it's still doing the same "bang-up" job *today!*

It's the quality ZALLEA builds into every expansion joint that makes them last . . . even in the severest service. There's *no* packing to deteriorate . . . *no* maintenance required. Once properly installed, they can be forgotten, with the full assurance that they will do the job intended.

Be sure! Always specify and *demand* ZALLEA Corrugated Expansion Joints.

Zallea Corrugated Expansion Joints are made in non-equalizing, self-equalizing and duo-equalizing types, depending upon the conditions under which they must operate . . . of copper, stainless steels and other corrosion-resistant alloys . . . diameters from 3" upward . . . traverses up to 7½" . . . for pressures from vacuum to 300 psi . . . for temperatures from sub-zero to 1600° F. Let us quote on your requirements.

"Code-Craft"...
ZALLEA BROTHERS & JOHNSON
...EQUIPMENT FOR THE PROCESS INDUSTRIES

814 LOCUST ST. • WILMINGTON 99, DEL.

Specify and Demand ZALLEA *Furnace-Annealed* **Expansion Joints**

FLEXIBILITY *and* STRENGTH *of* RIC-WIL CONDUIT PERMITS SHALLOW INSTALLATION *of* STEAM LINES

-even under Railroad Loadings

Underground steam line between RR sidings with expansion loop extending under tracks.

21 ft. Ric-wiL Prefabricated Insulated Pipe unit lowered into trench alongside tracks at RR passenger station without interrupting rail traffic.

Secret of the strength and flexibility of Ric-wiL units is in these corrugations. Seam-welded, helically corrugated, heavy gauge galvanized iron shell with full round smooth ends and special Ric-wiL coupler, provide pressure-tight construction.

The heavy-gauge helically corrugated shell used in Ric-wiL Prefabricated Insulated Pipe Units makes possible a resilient construction of high beam strength, which can safely be installed under E72 RR loadings with only 3 feet of ground cover, and under E90 loadings with only 5 feet. Because of this and other exclusive Ric-wiL features, the trend of engineering departments of railroads is to specify Ric-wiL for all underground steam lines. It is possible to jack Ric-wiL through existing right-of-ways and to install steam lines without disturbing sidewalks, pavement or tracks and without permanent deformation of roadbeds, thus saving both installation and maintenance expense.

(Left) Normal traffic was maintained on this busy downtown street while Ric-wiL units were installed under pavement. Units were jacked through from building basements and joined to utility's steam main at manhole in center of street. *(Right)* Close-up of manhole showing auger crew and tool for drilling under pavement.

See our exhibit at 17th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York, Booths 38 and 39.

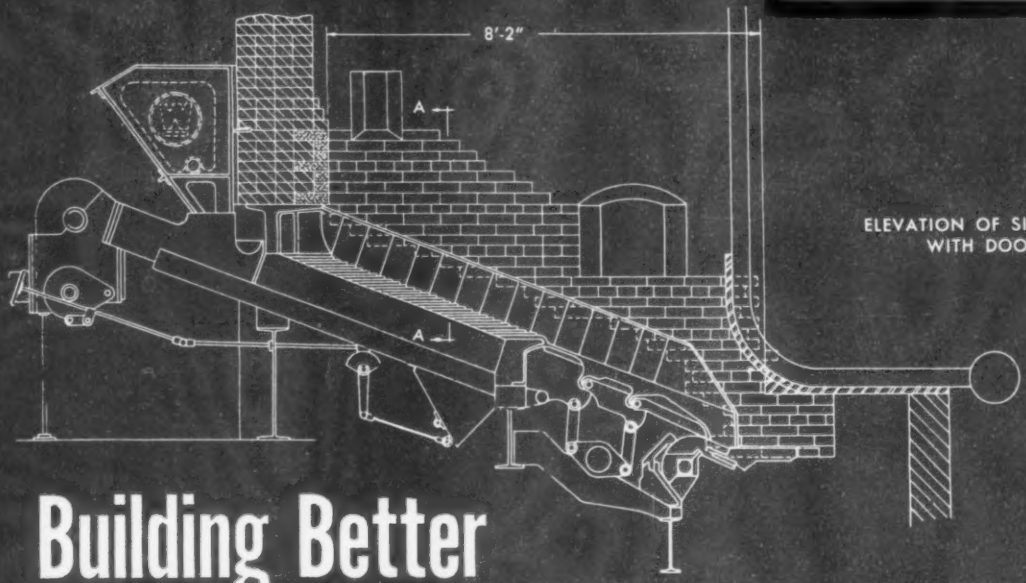
RIC-WIL INSULATED PIPE CONDUIT SYSTEMS

THE RIC-WIL COMPANY · CLEVELAND, OHIO

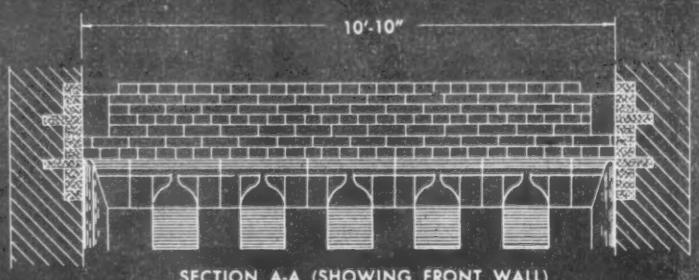
AGENTS IN PRINCIPAL CITIES

WALL BRICK DATA

WESTINGHOUSE Multiple Underfeed STOKER



Building Better Performance into Boiler Furnaces



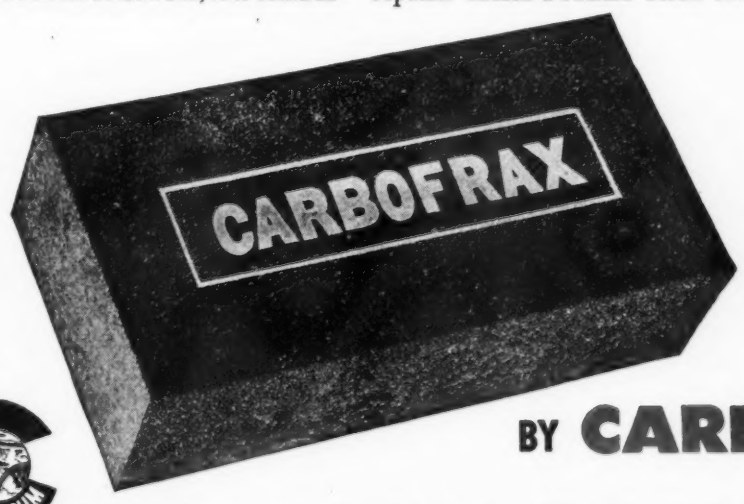
CARBOFRAX silicon carbide lining constructed to specified design for use with a Westinghouse stoker assures more low cost steam with less trouble. Individual operating characteristics of the furnace will, of course, determine the height of CARBOFRAX lining required for maximum efficiency.

In any furnace installation utilizing CARBOFRAX brickwork, fuel combustion is improved. The entire grate area is available at all times. Greater steaming capacity is attained. That is because draft choking clinkers can not cling to the hard dense surface of a CARBOFRAX lining. Even at temperatures far above those normally encountered, this clinker resistance is retained.

There are few if any outages for lining repairs. CARBOFRAX brick stoutly resist mechanical abrasion, spalling and cracking. Maintenance expense is practically non-existent. Continuous uninterrupted production adds still more to available capacity.

Built to last, CARBOFRAX brickwork regularly is reported on the job for 8, 10 and more years. Upper walls give more service too because they are firmly supported on a foundation that does not burn or cut back.

To realize better performance from your boiler furnaces, look into all the advantages of CARBOFRAX settings. Pertinent facts are clearly set forth in "CARBOFRAX in Boiler Furnaces," a copy of which is yours for the asking. We will be glad to supply more detailed information at your convenience. Write Dept. G-116, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



BY CARBORUNDUM
TRADE MARK

"Carborundum" and "Carbofrax" are registered trademarks which indicate manufacture by The Carborundum Company

Let's clean house now— start scrap moving—

FABRICATORS NEED STEEL

STEEL MILLS NEED SCRAP

Here's what you can do to help get much-needed scrap to Steel Mills.

1 ***Check Your Plant and Property*** and appoint someone to earmark every piece of machinery and equipment that can be cut up for scrap.

2 ***Consult Your Local Scrap Dealer*** to learn what size scrap brings highest returns—then flame-cut to size all obsolete machines, structural shapes, pipe, old boilers, and other large pieces.

3 ***Classify and Segregate*** alloy steels and other special materials to be sure they are used to best advantage and to obtain higher prices.

4 ***Move Scrap Fast*** when it is ready. Sell it, ship it—keep it moving.

Linde can help you work out a practicable scrapping program—just call our nearest office.

To help you identify the common metals for proper scrap classification, we will be glad to send you, without charge, as many copies as you need of the wall charts "Identifying Metals by Spark Testing" (ask for form 4666) or "Simple Tests for Identifying Metals" (ask for form 2299).

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

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EXPERT shop fabrication of sub-assemblies – as large as shipping facilities permit – makes possible simpler, faster, cheaper erection. These sub-assemblies – produced under ideal conditions and with the aid of equipment not always available in the field – are stress relieved, pressure-tested, checked for dimensional alignment, cleaned and inspected, and are ready to slip into place.

Pre-fabrication is economical and efficient for power piping of every type and material. Our engineers will be glad to discuss with you its applicability to your particular problem.

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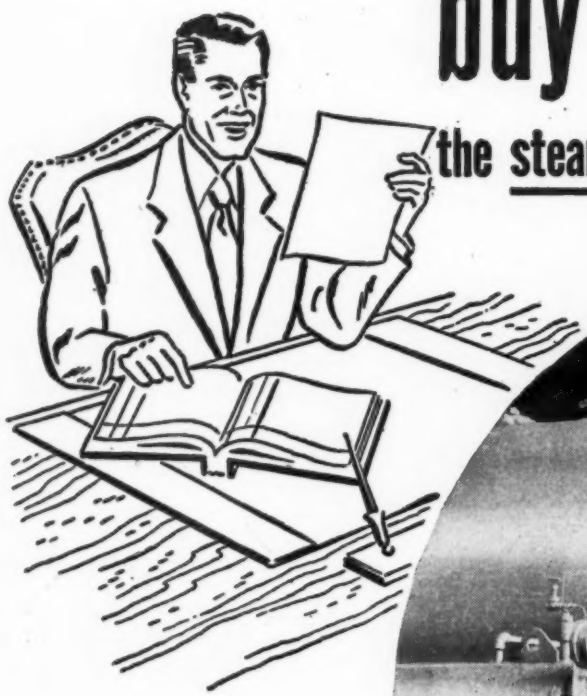
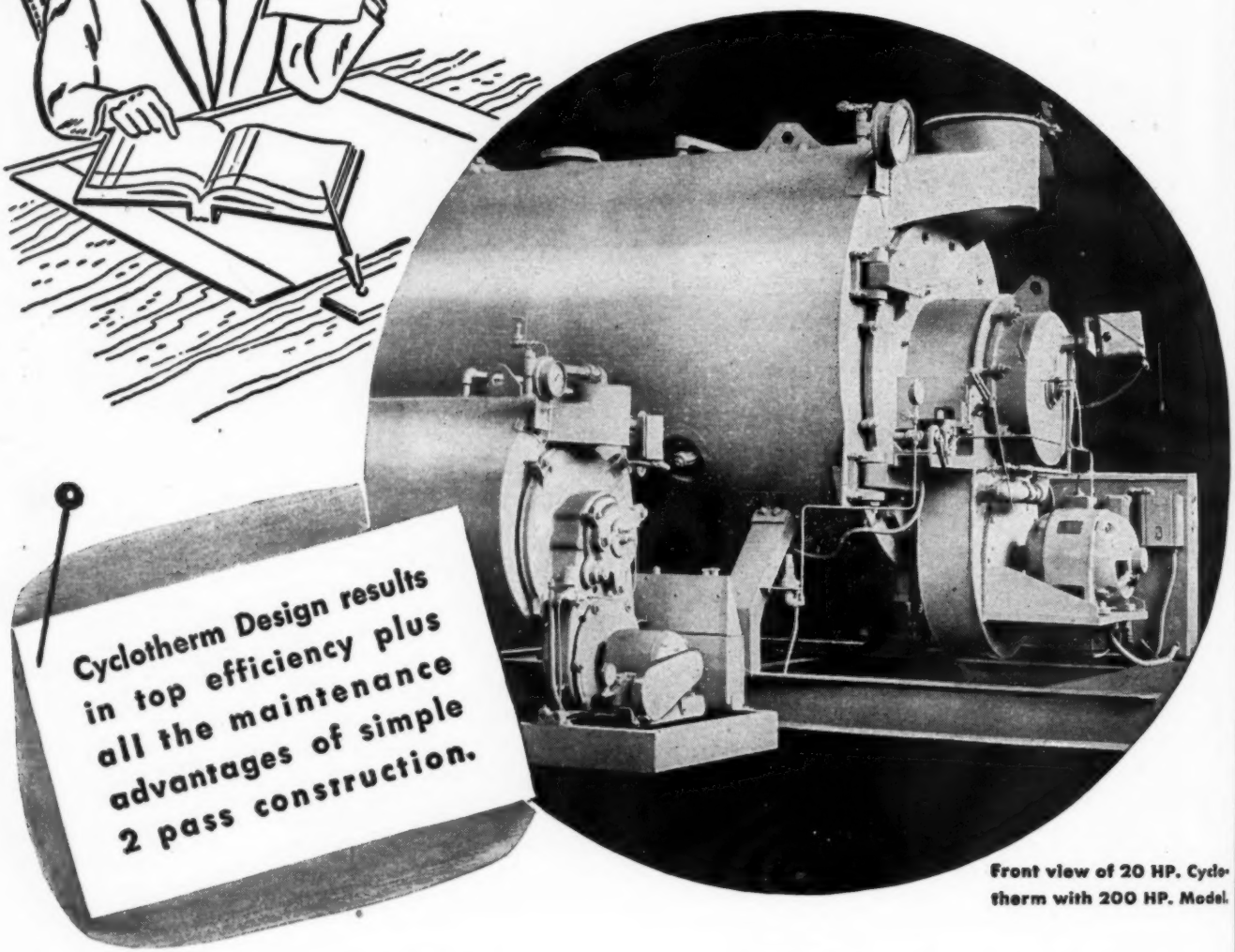
the steam generator that costs less to maintain





Front view of 20 HP. Cyclotherm with 200 HP. Model.

Cyclotherm's exclusive combustion method not only provides the highest efficiency of steam production and operation but also permits a greatly simplified over-all design including the use of 2 pass boiler construction. This combination of a more practical combustion principle and 2 pass boiler means longer fire tube life and fewer, easier inspections and clean-out jobs—*lower maintenance costs.*

Cyclotherm is manufactured in convenient sizes from 10 to 200 HP and with operating pressures from 15 to 200 psi. Units may be fired with any liquid or gaseous fuel and all operation is fully automatic. Heavy oil operation available in sizes 50 to 200 HP with automatic modulating controls. All sizes are also available with the Cyclotherm special combination burner arrangement to fire either oil or gas.

Initial cost and installation expense are low. Cyclotherm units are complete steam generating plants and are delivered to your door ready to operate on arrival.

Whatever your use of steam, there is a dependable Cyclotherm to do your job—and do it economically.

Wire, write or phone for more information

CYCLOTHERM STEAM GENERATORS

CYCLOTHERM CORPORATION, 90 BROAD STREET, BOX 402, NEW YORK 4, N. Y.

YOU CAN *stop that Carryover*

Are you one of the many in the unfortunate position of having to "baby" their boilers to prevent entrainment of boiler water solids with the steam?

Such entrainment may lead to deposits in steam lines, superheaters, turbines and other process equipment. These solids may also interfere with process operations as in the case of breweries, laundries, etc.

Most cases of carryover are due to the combined effects of suspended and dissolved solids in the boiler water. If either is decreased, more of the other can be tolerated. Dissolved solids can be decreased by blowdown but this has little effect on suspended matter. If, however, the suspended matter is coagulated properly it will drop rapidly to the lower parts of the boiler where bottom-flash blowing will remove it with little loss of water.

Ameroid Coagulants, used in conjunction with proper chemical treatment, have proved to be excellent for this purpose. In addition to coagulating the suspended matter, they make the sludge non-adherent to metal, thereby eliminating baked-on deposits.

Contact **the Drew man and find out how AMEROID, The Complete Boiler-Water Treatment, can be used to "lick" your carryover problem.**

AMEROID

THE COMPLETE BOILER WATER TREATMENT

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COMPLETE AMEROID SERVICE is available in key cities of the United States, Canada, Mexico, Brazil and Puerto Rico.

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82

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Investigation of Tube Failures Leads to Selection of Better Alloys

The extensive field studies made by Bridgeport metallurgists, in cooperation with marine and power plant engineers, are playing an important part in lengthening tube life and in laying the groundwork for improved operating efficiency.

Service conditions, which are not generally the same in two different localities, and often vary even in two similar condensers in the same plant, are responsible for excessive corrosion resulting in shutdowns and interruptions in the flow of power or vital production.

In many cases, it is possible to select one or another of the existing condenser tube alloys which will best withstand given conditions. However, the subject of corrosion is a complex one, and each installation should be treated as a special case.

Microstructure No Influence on Corrosion Resistance

There has been no evidence presented to date which would indicate any direct relationship between microstructure (fine grain, coarse grain, non-uniform grain or cold worked structure) and service life.

It has been thought by some that a particularly fine grained structure was essential to tube endurance. Because of the fact that the tubes in a condenser will usually show a considerable variation in grain size, it would follow if this were true, that the earlier failures would generally occur among the coarser grained tubes, while the finer grained ones would show a comparative absence of them. Repeated examinations by our Research Department have failed to detect the existence of any such relationship. Numerous instances have been found in which the failed tubes exhibited the finer structures.

Effect of Composition

The addition of one or more alloying elements to copper produces alloys with varying degrees of corrosion resistance. For example, tin, silicon, aluminum, nickel, iron, zinc, arsenic, etc., added singly or in combination result in the standard condenser tube alloys. These alloys vary greatly in their corrosion resistance to sea water, fresh water, polluted waters, hydrogen sulphide, ammonia, pharmaceuticals, organic or inorganic acids, salts and alkalies, as well as to stress corrosion.

Generally, when it is possible to obtain all the facts in a given instance of long condenser tube life or premature failure, some unsuspected difference in alloy composition, water composition, or other factor will be revealed. It was only through long and careful studies that British condenser tube investigators discovered that arsenic in small concentrations is effective in preventing dezincification in brass.

Corrosion Research

The research work which is constantly being carried on by Bridgeport's laboratory includes investigations dealing with the behavior of different metals and alloys when partly or completely immersed in various corrosive media such as sea water, acids, alkalis, etc. The data obtained when correlated with information gathered from our field experience are helpful in the recommendation of existing alloys for specific conditions as well as in the development of new and improved alloys.

It has been found, for example, that by the addition of a small percentage of an inhibitor to the solution, the corrosive action of an acid such as dilute sulphuric can be reduced to such an extent that no attack takes place even at the water line although similar samples in the same solution but without the inhibitor will dissolve completely at the waterline in 2½ months.

Likewise, the addition of a small percentage of alloying material may have a profound effect on an alloy's resistance to certain types of corrosion. Such studies point the way to the development of alloys with increased corrosion resistance.

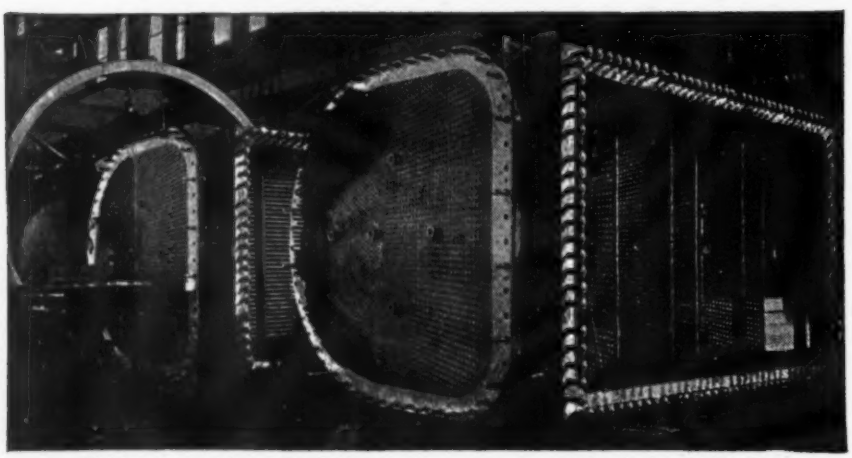
In most environments metals tend to change into some more stable combinations, such as the metallic ores from which they were obtained. Moisture or water accelerates the return of the metal to metallic compounds. It is for this reason that we are generally more concerned with the corrosion of metals called upon to handle naturally occurring waters and industrial solutions or liquors than with metals which are kept in a dry state. ●

Much valuable data has been collected through the years on the service life of various condenser tube alloys used under many different types and conditions of operation. Naturally, close cooperation between the power plant operator, his own laboratory, if he has one, and the Bridgeport laboratory, pays off. Careful records covering the behavior of existing tubes and that of sample alloys will prove invaluable when it is necessary to decide which tube alloy should be selected when retubing is in order.

Many problems confront the operator, and our Laboratory is asked to help solve problems such as the following:

- Which alloy will give best results when retubing?
- How to increase corrosion resistance.
- How can heat transfer be improved?
- How to reduce effects of Biofouling.
- How to reduce dezincification. Pitting.
- How to resist impingement corrosion.
- How to prevent premature failure from cracking.
- How to resist corrosion from organic pollution.
- What effect will a certain amount of ammonia have on the steam condensate?
- Is there a critical water velocity?
- What is life expectancy of tubes?
- Effect of pH on condenser tube life, and many, many others.

Write for a copy of Bridgeport's 112-page Condenser Tube Manual. Call our nearest office for any service we can render through our Laboratory or Technical Service Department.



Tubing of two 7,500 sq. ft. Surface Condensers—Courtesy Allis-Chalmers Mfg. Co.

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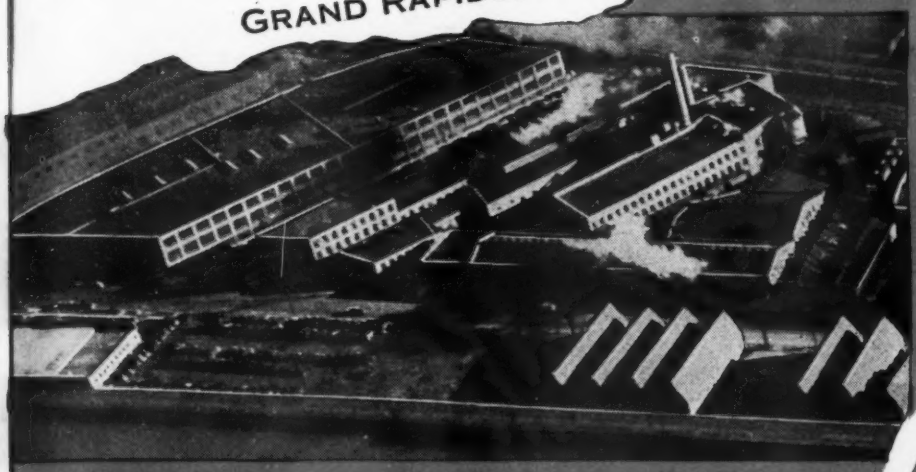

DETROIT ROTOGRATE STOKER

First Detroit RotoGrate Stoker Installed in 1942 American Box Board Company, Grand Rapids, Mich.

Repeats

ANOTHER DETROIT ROTOGRATE STOKER

merican Box Board Company, manu-cturers of container board and con-iners, have used a RotoGrate Stoker pplied to a steam generator since 42. The rated capacity is 110,000 unds of steam per hour. Another der now calls for an additional Roto-Grate Stoker for a new 75,000 pound unit.

Detroit RotoGrate permits high burning rates with fuels of either high or low ash content. *Continuous Cleaning—Forward Moving Grate* Spreader Stoker—it quickly responds to load changes.

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You get trouble-free operation with TODD BURNERS

. . . and the care with which TODD engineers watch the installation has a lot to do with it!

Todd agrees 100% with the old saying—*"an ounce of prevention is worth a pound of cure."* Our engineers watch installations with the utmost care. This policy bears fruit over and over again in trouble-free, low-cost operation, as our customers often take the pains to tell us.

Savings on maintenance, however, are only the beginning of the economy story of Todd Burners. In record after record, Todd Burners have cut fuel consumption as much as 10% or more, while stepping up power capacity substantially.

Todd Burners are available in many standard and modified types. Each job is engineered individually, to provide exactly the right application for the power needs of your particular factory or commercial building.

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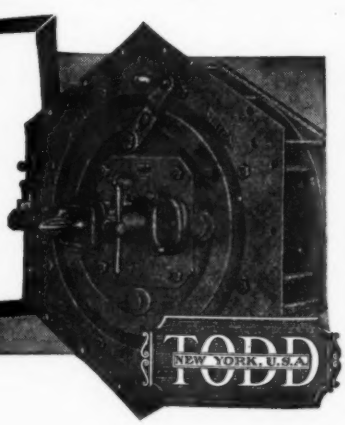

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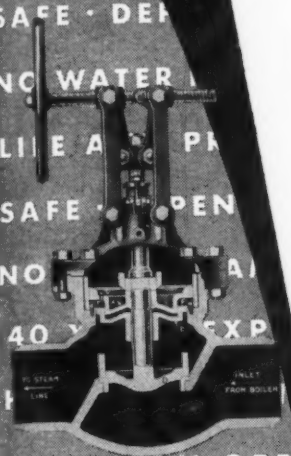
Check the Type of Valves you need and mail to Golden-Anderson for complete information.



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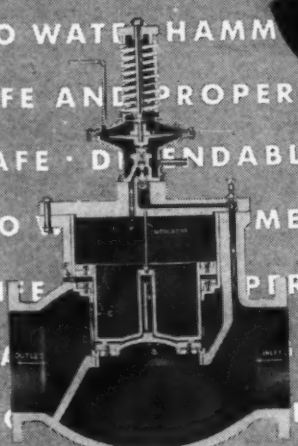

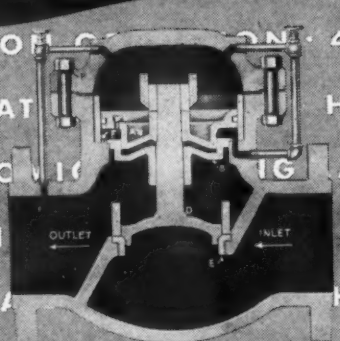

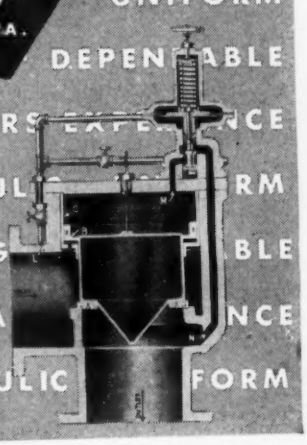

5 H.P. or 5,000 it's all the same to Timken Bearings

Transmitting power through gear reduction units — big or little — imposes multiple responsibilities on bearings — and it takes a *multiple ability* bearing to meet them all successfully.

Timken Tapered Roller Bearings have proved themselves masters of gear reducer service in all types and sizes of units — from fractional horsepower combination motor reducers to huge steel rolling mill drives similar to those shown here transmitting thousands of horsepower.

They have every required mechanical quality in maximum degree — friction elimination; radial, thrust and combined load capacity; and ability to hold shafts and gears in correct and constant alignment. In addition they possess the tremendous shock resistance and endurance imparted by Timken Alloy Steel — the finest material ever developed for tapered roller bearings.

Look for the trade-mark "TIMKEN" on every bearing you use in gear reduction units or machinery of any kind. The Timken Roller Bearing Company, Canton 6, Ohio.

Tapered Roller
TIMKEN BEARING
EQUIPPED

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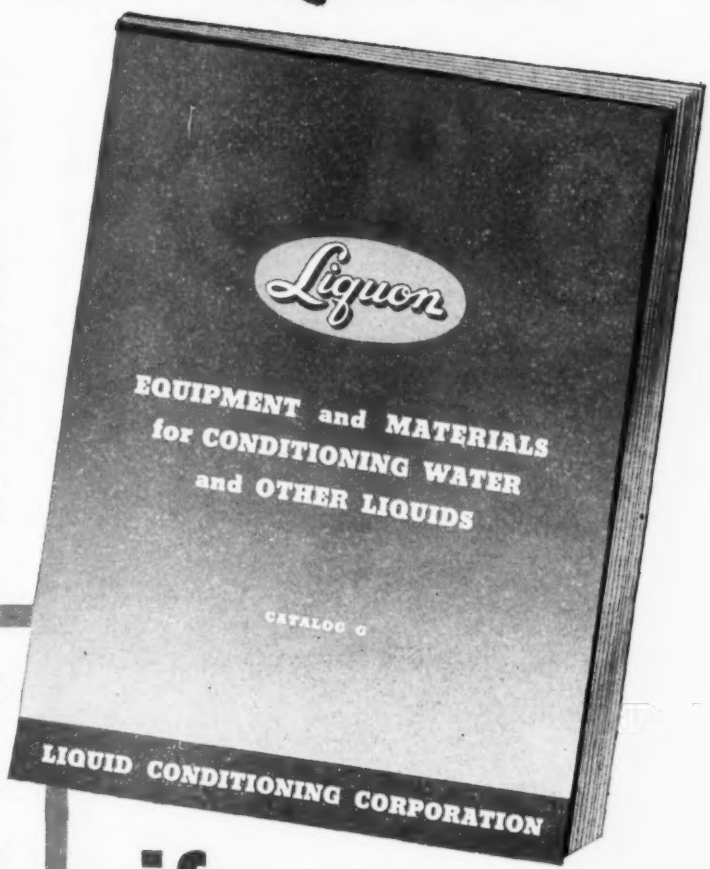
TAPERED ROLLER BEARINGS

The Latest Word in the **CONDITIONING** *of* **WATER** *and* **OTHER LIQUIDS**

This helpful guide book on conditioning of water and other liquids has been prepared by leading authorities with more than a quarter century of specialized experience in this field.

It clearly explains and compares the many different processes and describes the most modern and effective methods and equipment for softening and clarifying water, and also for removing undesired impurities or recovering valuable constituents from other liquids. It will help you to determine the most practical conditioning method for your particular requirements, and to check the possibilities for modernizing and improving your present process.



Some of the Subjects Covered

WHY are different methods of water treatment in use?

HOW do these different methods of water treatment compare in the results obtained?

WHERE should each of the different methods of water treatment be used?

WHAT are the most advanced methods and equipment for water treatment?

WHICH is the most effective water treatment for removing hardness . . . alkalinity . . . minerals . . . turbidity . . . gases . . . other impurities?

WHEN can an existing water treatment installation be made more efficient with the same equipment?

if your plant operations require water treatment or liquid conditioning of any kind, this 60-page bulletin may point the way to important improvements or economies.

LC 106

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COMPANY.....

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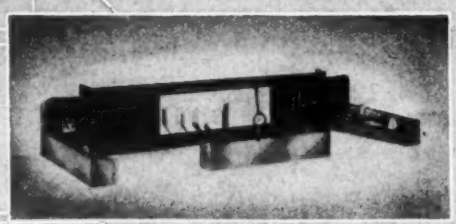
423 West 126th Street, New York 27, N. Y.
Offices in Principal Cities

Thermix Products at the

1946 POWER SHOW

GRAND CENTRAL PALACE, NEW YORK CITY



For the first time since the war, Thermix Products will be on display at the New York Power Show.

Many new developments are to be seen and you are cordially invited to drop in at booths 50 and 51.

High on the list of attractions will be a full scale working model of a Thermix Duplex Dust Collector using alternately an Aerotec tube and Aerotec electrical secondary. Heacon Dampers will control flow and a Thermix Fan Stack will furnish the draft. Sides of the equipment will be transparent for observation.

Our engineers will be on hand to welcome you and answer any inquiries.

THERMIX ENGINEERING CO.

GREENWICH, CONN.

Project and Sales Engineers for

PRAT-DANIEL CORPORATION • AEROTEC COMPANY
HEACON, INC. • ROCKWELL BLAST GATES

"Okay, I've paid off . . . now tell me how you did it!"

YOU KNOW, boss, I really earned this hat. Just think what it would have cost if we hadn't gotten those new boilers covered on time."

"Sure, but quit stalling. How did you do it? Where did you find the materials?"

"Well, it took a lot of careful planning . . ."

"And how about the pipe coverers? How did you round them up so fast? From what I've heard, it's almost as hard to find mechanics as it is materials."

"That's right, but I'll let you in on a secret. I did a lot of checking around and then contracted with Armstrong Cork for the whole job."

"You mean Armstrong came through with the materials and the workmen, too?"

"Sure did, and their mechanics are good. Next time you're out near the boiler room, stop in and see what real insulation work looks like."

"Okay, but answer me this. When you made the bet, how sure were you that the job would be done on time?"

"Boss, it really wasn't too much of a gamble. Armstrong has warehouses and crews of workmen all over the country. And I knew they line up enough materials and men to see a job through before they sign. Nice hat, isn't it?'

* * *

Our contract service for heat insulation offers special benefits to you. In addition to quality materials and skilled mechanics, we also provide expert engineering service. When we take on a job for you, this triple service assumes all responsibility for seeing it through.

Free! New Insulation Chart

If you use insulation, you'll want a copy of a new chart recently developed by Armstrong. This check list shows which kind of insulation, and how much of it, can most profitably be used to hold any given temperature from 300° below zero to 2800° F. For your free copy, write to Armstrong Cork Company, Industrial Insulation Department, 7011 Maple Avenue, Lancaster, Pa.

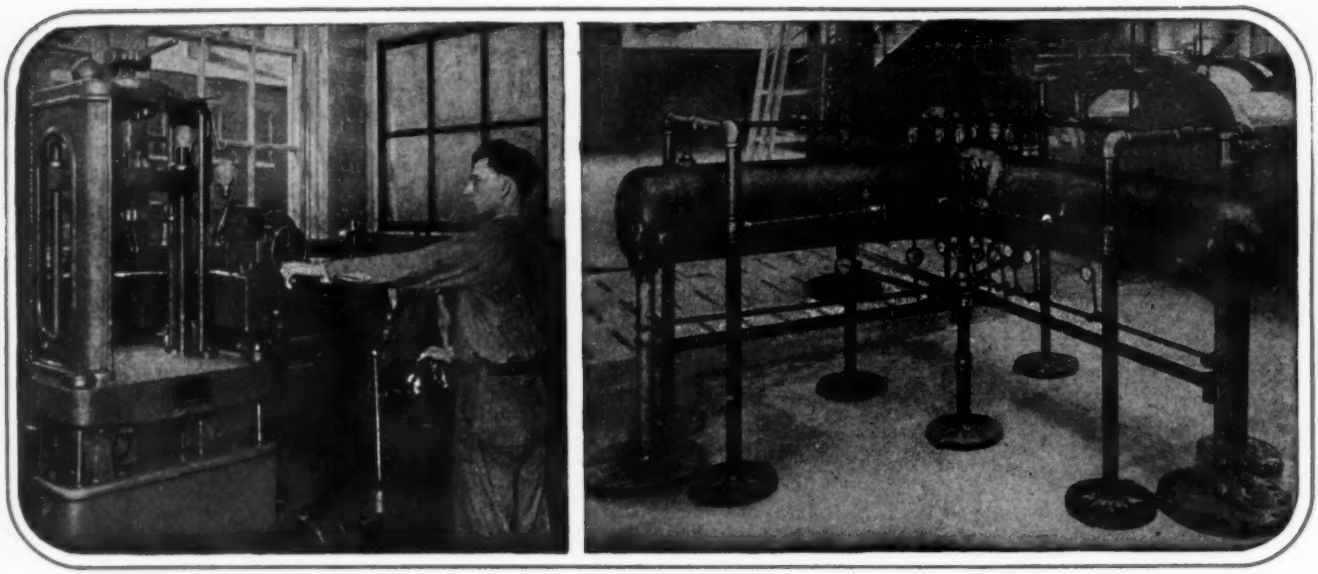
ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

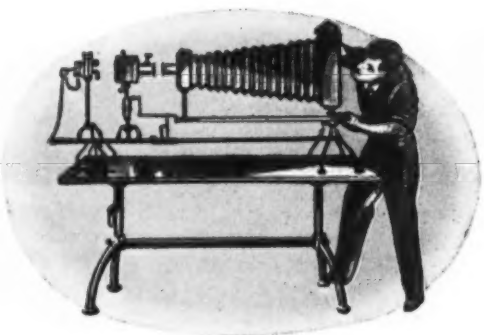
From 300° Below Zero

To 2600° Fahrenheit

RESEARCH TODAY . . .



. . . The Foundation Of BETTER PRESSURE PIPING



TOMORROW

If we are to have better piping tomorrow, we must develop improved methods and materials today. Accident cannot be depended upon to bring about this development—it can come only through research.

Therefore, qualified members of the Pipe Fabrication Institute conduct continuous research for the improvement of pressure piping in general, and pre-fabricated piping in particular. Included are studies in the behavior of piping under high pressures and temperatures . . . physical tests of weld specimens . . . metallurgical investigation to determine possible changes produced by processing . . . photomicrographic and radiographic inspections, etc.

An additional and immediate benefit of this research is its use in maintaining quality over the entire range of *shop* fabricating processes. This is one of the important advantages of shop pre-fabricated piping—today as well as in the postwar period.

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING • PITTSBURGH, PA.

An Important Announcement!

At the Power Show in New York, we will introduce a new Remote Reading Boiler Water Level Gage.

This gage incorporates many improvements. Working models, demonstrating the fundamental principles, will be on exhibit in Booths 254-255 and we look forward to discussing the details with you at the show. Our display will also include the new Jerguson Water Column with high water and low water alarms, as well as many other Jerguson products.

This exhibit will be well-worth seeing . . . the new Jerguson products well-worth investigating.

JERGUSON GAGE & VALVE CO.

93 FELLSWAY SOMERVILLE 45, MASS.

LIST OF REPRESENTATIVES

Appleton, Wisconsin
Atlanta 3, Georgia
Chicago 2, Illinois
Cincinnati, Ohio
Cleveland 14, Ohio
Denver, Colorado
Detroit 4, Michigan
Houston 1, Texas
Kansas City, Missouri
Los Angeles 6, California
Marshalltown, Iowa
Memphis 3, Tennessee
Minneapolis, Minnesota
New York 17, New York
Philadelphia, Pennsylvania
Pittsburgh, Pennsylvania
Portland, Maine
Portland 8, Oregon
San Francisco 4, California
Seattle 9, Washington
St. Louis 11, Missouri
Tulsa 12, Oklahoma
Mexico, D. F.

ALL OF CANADA: Peacock Bros. Ltd., Montreal 13

AN IMPORTANT NEW DEVELOPMENT IN WATER CONDITIONING!

Sludge Blanket Hot Process

Greater Economy in Chemical Cost—
Greater Efficiency in Removal!

The Permutit* Sludge Blanket Hot Process reduces turbidity of softened water, lessens the load on filters, reduces the amount of backwashing and lowers the amount of silica left in the water.

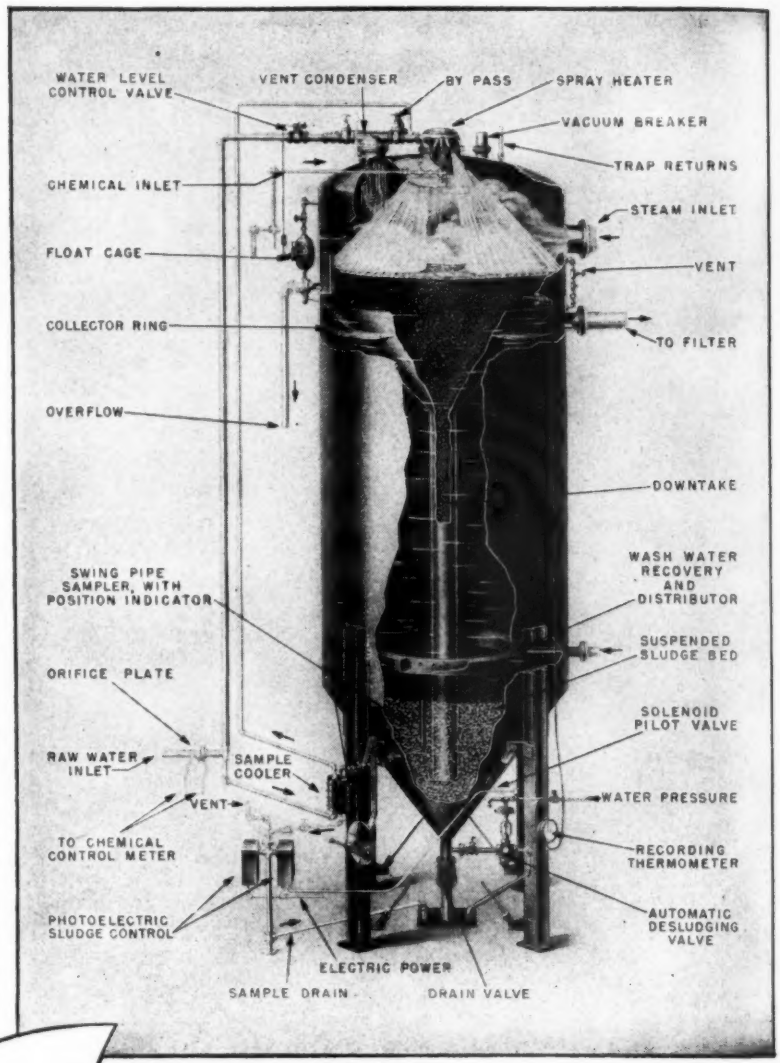
Low turbidity, a feature of this new Sludge Blanket design, effects considerable chemical savings because of its low consumption of expensive phosphate reagent. In addition, the new process reduces the amount of lime required to soften water, since unconsumed lime is retained in the blanket until it reacts with water hardness.

A higher degree of silica removal is possible with this new model because each particle has an intimate, prolonged contact with silica-absorbing magnesia.

The depth of the sludge bed is controlled by an automatically-operated desludging valve actuated by a photoelectric turbidity detector. This detector automatically checks a continuous water sample and opens the desludging valve whenever necessary to reduce turbidity to the desired value.

Write today for free, informative bulletin, "Improved Permutit Hot Process Water Softener." Address The Permutit Company, Dept. P 11, 330 West 42nd Street, New York 18, N. Y., or Permutit Company of Canada, Ltd., Montreal.

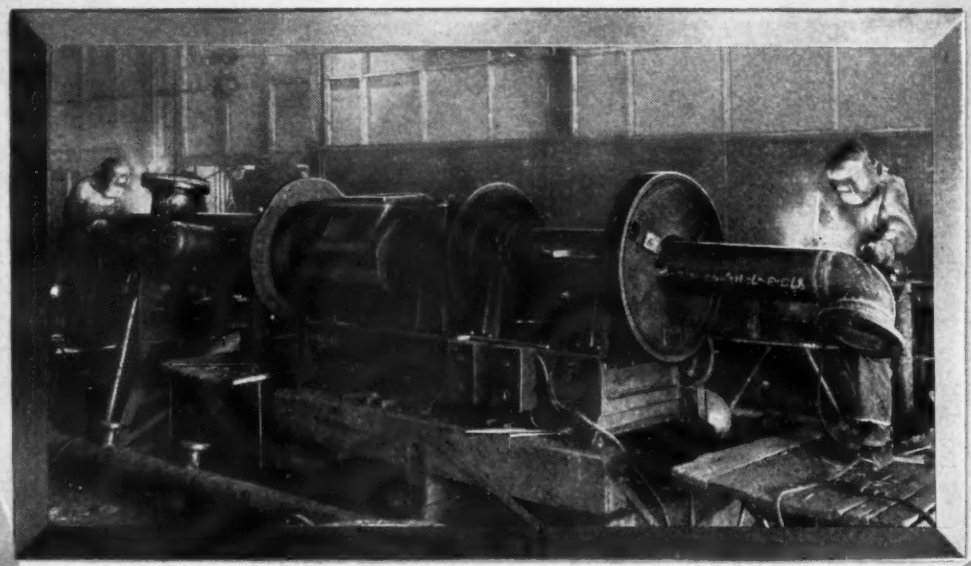
*Trademark Reg. U. S. Pat. Off.



Permutit Pioneers Again!

PERMUTIT

WATER CONDITIONING HEADQUARTERS



"As One User to Another"

MIDWEST Talks About PIPE WELDING FITTINGS

When you buy Midwest Welding Fittings, you get the same fittings that we use by the thousands in our own shop fabrication and field erection. So we can talk about pipe welding fittings "as one user to another."

We *know* that Midwest Welding Fittings save time in prefabricating piping . . . and in erecting piping in the field. Their sound design, dimensional accuracy and uniformity are features which are of definite help in making the job easier . . . in saving time and money . . . in providing better piping.

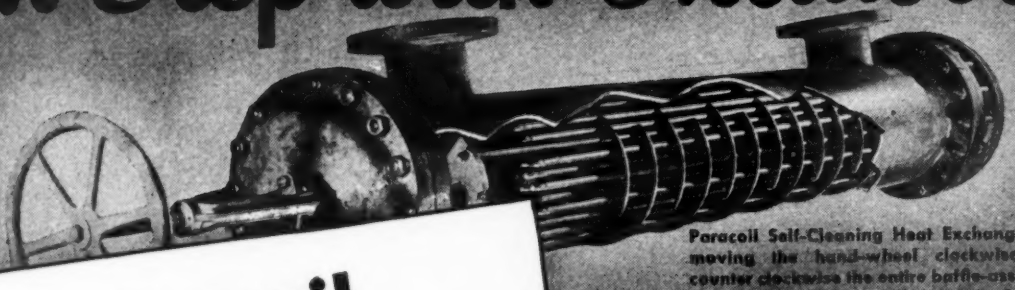
We *know* that the large variety of Midwest Fittings is another time and money saver . . . in addition to improving piping practice. We have reference to such Midwest developments as reducing elbows, "long tangent" elbows, shaped nipples, etc. See Bulletin WF-41 for complete information.

MIDWEST PIPING & SUPPLY Co., Inc.

Main Offices: 1450 South Second Street, St. Louis 4, Mo.

Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St. • Distributors in Many Cities

In Step with Industry



Paracoil Self-Cleaning Heat Exchanger. By moving the hand-wheel clockwise and counter clockwise the entire baffle-assembly is moved back and forth over the heating surface thus scraping any deposits from the tubes. Cleaning action is positive and effective. Ideal for heating fuel oil and other fouling liquids.

Paracoil

HEAT TRANSFER EQUIPMENT

Davis Engineering Corporation has played a major part in the development, design betterment and manufacture of distillation, evaporation and heat exchange equipment for more than 30 years.

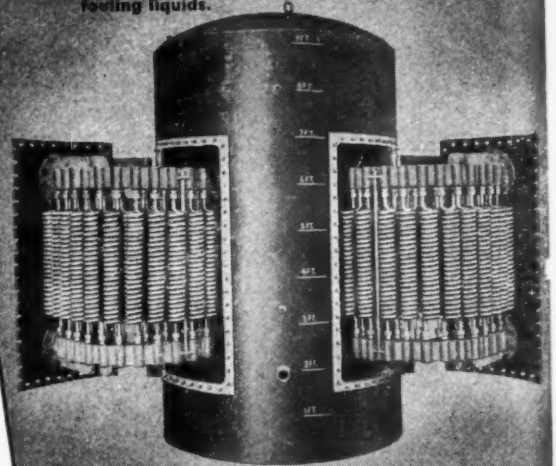
Pictured are Paracoil Heat Transfer units designed to serve America's industries as well in peace as they served the country during the war. Davis built heat exchangers assure greater production efficiency, reduced repair and cleaning costs and freedom from shutdown losses.

Paracoil equipment is available for practically every type of heat transfer application called for by our many and varied industries.

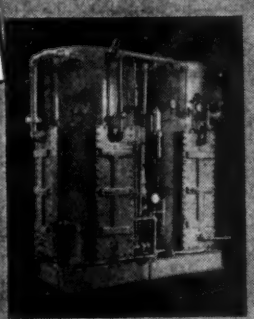
Technical and practical knowledge accumulated from 30 years of manufacturing experience and job performance, supplemented by continuous engineering research, have resulted in fundamental design improvements effecting advanced performance and increased resistance to severe service conditions.

Whether yours is a replacement, new, or more efficient equipment need, Paracoil Heat Exchangers are available on most reasonable delivery schedules and Davis engineers are ready to assist in making proper selection of size and design best suited for your particular problems.

To those with fouling problems: Write for bulletin HE-100 describing the Paracoil Self-Cleaning Tubular Heat Exchanger.

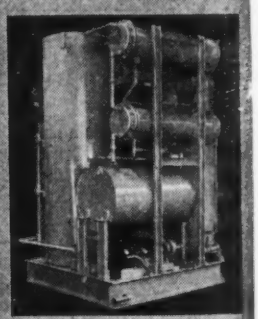


Paracoil Double-Door Evaporator. Note accessibility of all the heating surface for inspection, cleaning and ease of repair. Available in single and multiple effects and in a wide range of capacities.



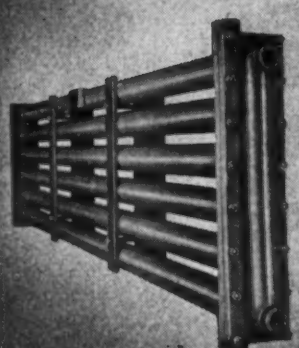
FRONT VIEW

Triple Effect Package Type Distillation plant built for supplying distilled water from sea water or contaminated water for drinking and process service. Illustrates Paracoil hinged door evaporators. A completely self contained unit.



BACK VIEW

This distillation unit has a capacity of 180 gallons per hour with low pressure steam and economical steam consumption. Other package types standardized for a number of capacities.



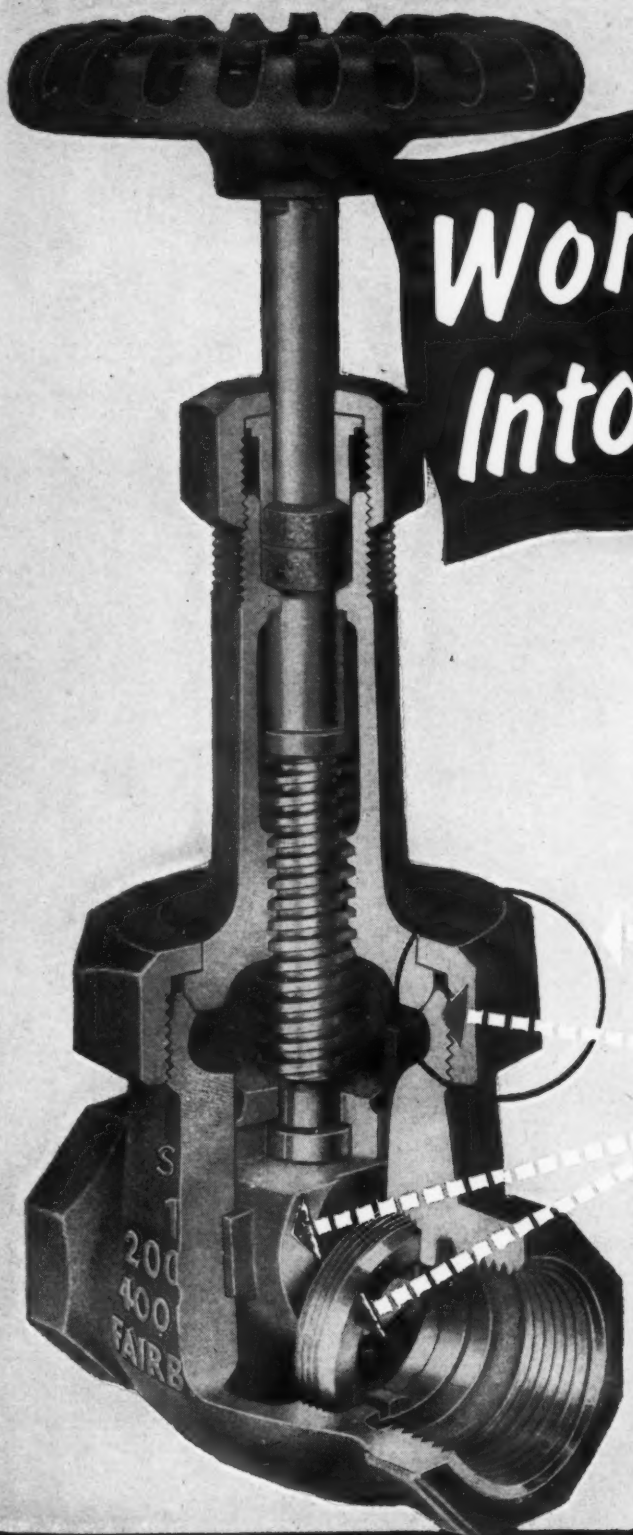
Gas to Gas Heat Exchanger. This type of Paracoil Heat Exchanger has many industrial uses for transfering heat between gases or liquids, or between gases and liquids. Unit illustrated constructed entirely of Inconel. Can be furnished in other alloys or carbon steel.

Liquid to Liquid Exchanger. Special liquid to liquid exchanger for counter current flow, six pass on both shell and tube sides. Most efficient design for stressing temperature conditions. Straight tubes easily cleaned.

SINCE 1915
Paracoil
HEAT TRANSFER EQUIPMENT

DAVIS ENGINEERING CORPORATION
106A EAST GRAND STREET ELIZABETH 4, NEW JERSEY

American industry flows through fairbanks valves



Worth Looking Into

...One Fairbanks Valve
...Three Fairbanks Features

Union Bonnet Bronze Gate Valve for 200 lbs. Steam, 400 lbs. Water, Oil and Gas Pressure (Non-Shock)

While no picture can do full justice to ruggedness of design and construction, the big cutaway view gives you at a glance the most important features of a widely applicable valve suited for severe operating conditions in processing and other work.

- Union bonnet construction provides for easy dismantling and reassembly where frequent cleaning or inspection is necessary. Threads on outside of body are not subject to attack by fluids in line.
- Heavy octagonal bonnet nut holds radial body bonnet joint in pressure-tight alignment.
- Nickel alloy wedges and renewable seat rings provide extra long service through hardness and resistance to corrosion under pressure. Valve may also be had with integral bronze seats.

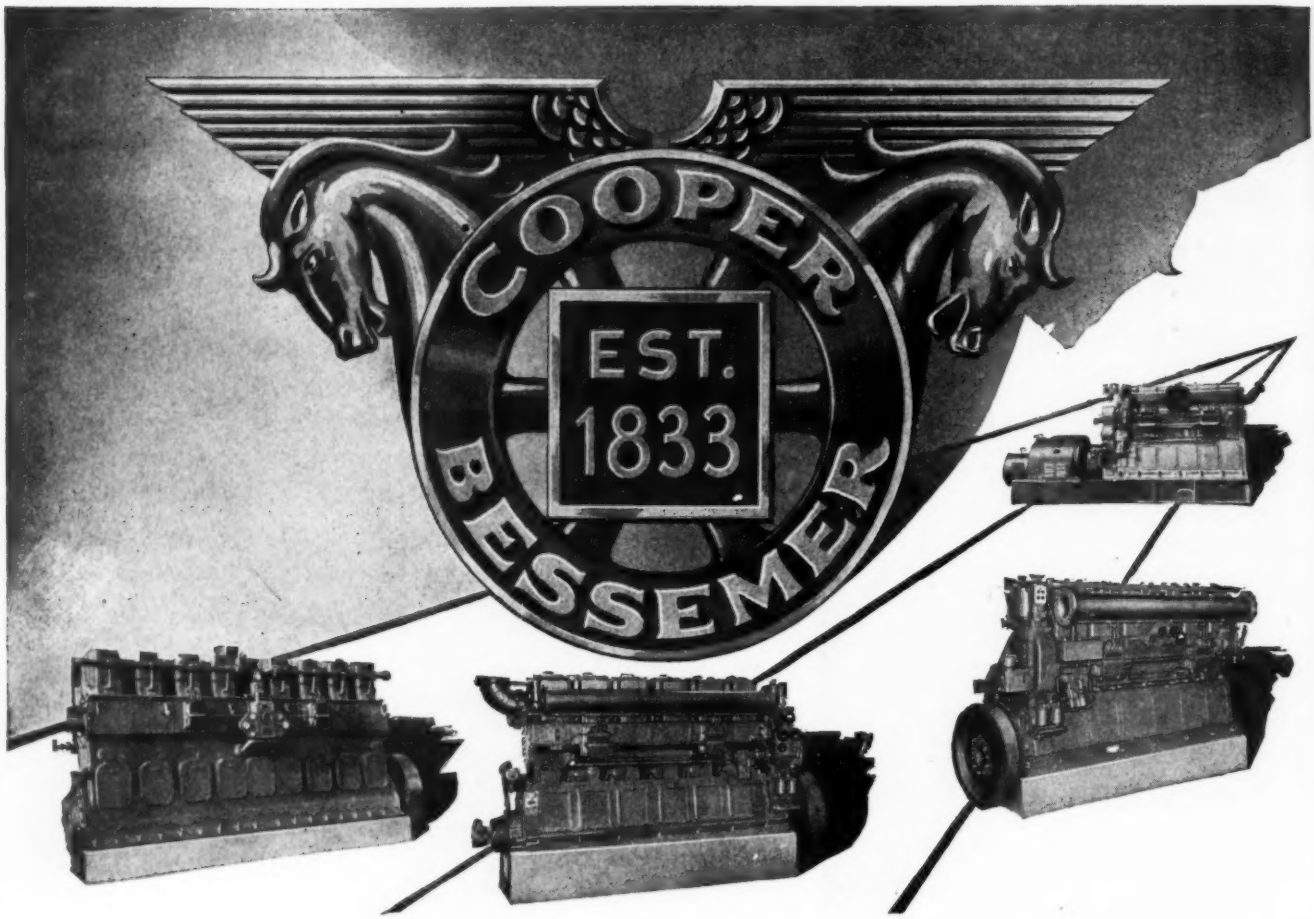
This valve is furnished with rising or non-rising stem. Low in maintenance cost, this 200 lb. bronze gate valve is typical of the Fairbanks line of bronze, iron body, and all-iron valves. Write today for further information.

THE **fairbanks** COMPANY

393 LAFAYETTE STREET, NEW YORK 3, N. Y.

520 Atlantic Ave., Boston 10, Mass. 748 M & M Bldg., Houston 2, Texas 15 Ferry St., Pittsburgh 22, Pa.

IT'S WORTH LOOKING INTO *BY EVERY INDUSTRIAL DISTRIBUTOR* interested in a feature-crammed profit-building valve item "made to order for orders" . . . strongly backed by the long-established name of a well-known manufacturer.



Sign of Diesel Performance at its Best

THE emblem you see above appears on every Cooper-Bessemer Diesel, symbolizing 113 years of fine engine building. It has present and future significance as well. It means engines today that are better than ever . . . engines tomorrow that are still better than today's. For at Cooper-Bessemer, continuous progress is a century-old habit. This habit pays off to power users . . . pays off in Diesel stamina, efficiency, and all-around performance at its very best!

Cooper-Bessemer diesels range from 100 to 2000 horsepower, supercharged and atmospheric, for all marine, locomotive and stationary services. Get in touch with the nearest Cooper-Bessemer office for specific information.

The
Cooper-Bessemer
Corporation

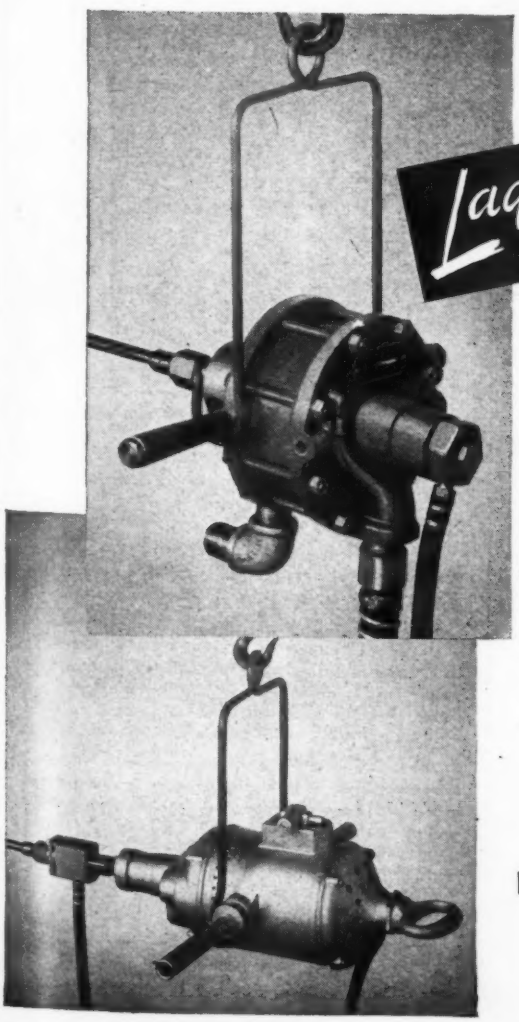
MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington Tulsa Dallas Seattle
St. Louis Houston Los Angeles Shreveport
Calmes Engineering Company, New Orleans, La.

Elliott has the answer *for small tube cleaning*

Lagonda 600 SERIES

For tubes with soft, thin scale or slushy deposits. This "mighty midget" of the Lagonda family has inherited all the speed and power characteristics which have made its "big brothers" famous in the field of large tube cleaning. It's fast and agile on both straight and curved tubes and has a wide range of cutters, brushes and scraper heads so that it can clean any straight tube down to 19/32" I.D. and curved tube to 25/32" I.D. Motor is air or steam driven.



Lagonda SUSPENSION CLEANER

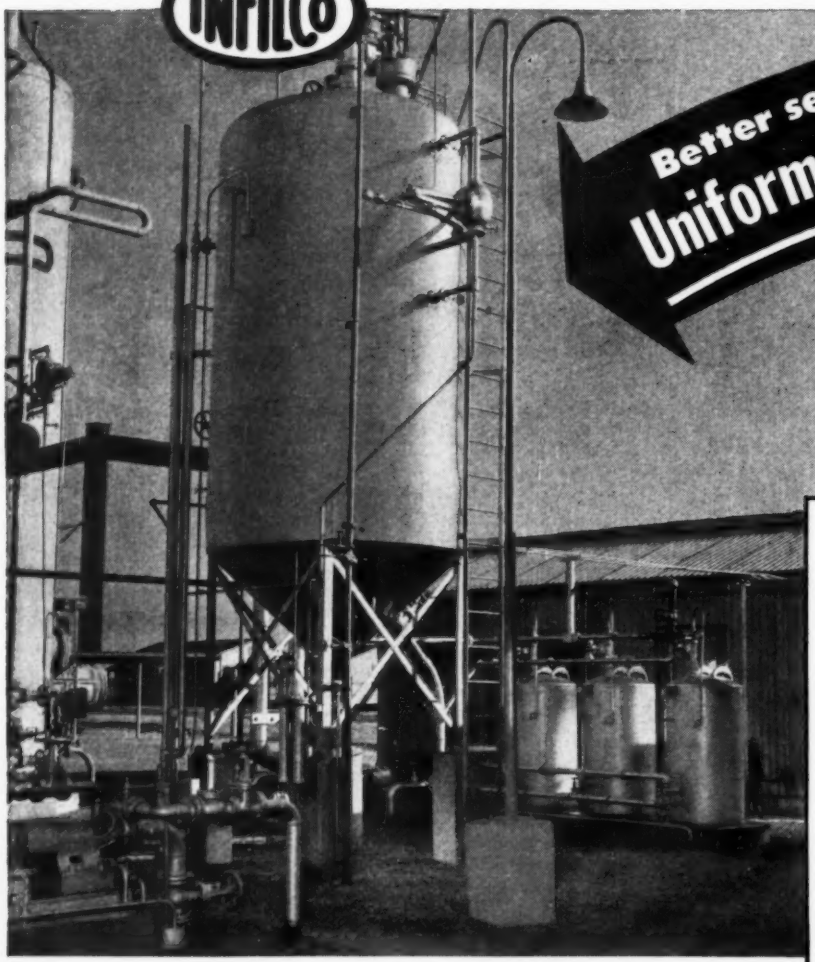
This is the cleaner for straight tubes with hard, flinty deposits. The motor is suspended outside the tube and drives a long shaft, with cutter head attached, into the tube to be cleaned. Motors are air (or steam) and electric. Steam or air motors may be either direct-drive (illustrated at left), or geared. Electric motors (lower left) are available in either light or heavy-duty models. The Lagonda Suspension Cleaner is the answer for many difficult small tube cleaning problems in the process field, as well as in the power plant.

Elliott engineers are ready to consult with you on any specific application. An informative Small Tube Cleaning Bulletin is available on request. Write for your copy.

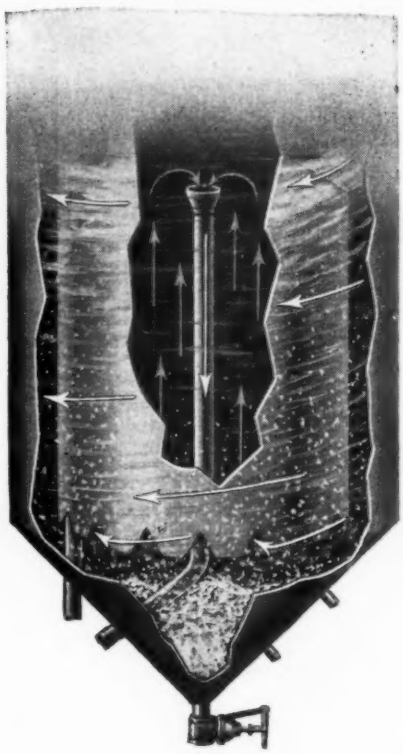
ELLIOTT COMPANY
***Lagonda Division*, SPRINGFIELD, OHIO**
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

Y-264

INFILCO



Better sedimentation produces Uniform Boiler feed water



One unit solved *three* worries at this plant . . .

Raw water at this southern refinery is the troublesome type. Not *properly* treated, it could cause hard, glassy scale, sludge and foaming. Reasons for this not-too-happy outlook are silica, hardness and high alkalinity. So in installing treating equipment, guesswork wouldn't do. These were questions for considered answers . . . from INFILCO engineers.

In this case, as in many others, proper treatment centered around *effective* reactions with selected chemicals in the sedimentation tank. Dissolved silica, hardness and alkalinity had to be reduced to harmless amounts. These objectives were established by careful analysis of the raw water, and here are the results.

Thorough mixing of heated raw water and chemicals begins in the mixing compartment of the INFILCO Sedimentation Tank. From this turbulent zone, the water flows in a quiet spiral that allows time for *complete* chemical reaction. Reaching the bottom of the tank, it flows upward, fully treated, to the settled water take-off. That sequence continues its day-in, day-out job of removing the trouble-causing elements from the water at this plant. It's one of the examples of reliable analysis and dependable performance that characterizes Hot-Flow installations the country-over. INFILCO INC., 325 West 25th Place, Chicago 16, Illinois.

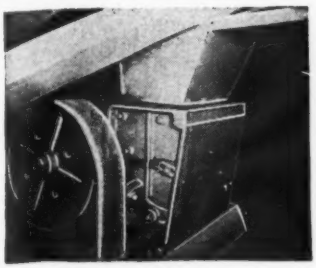
It's the *internal* design that produces *better* chemical mixing, *better* solids separation and *better* sedimentation in the Hot-Flow Tank.

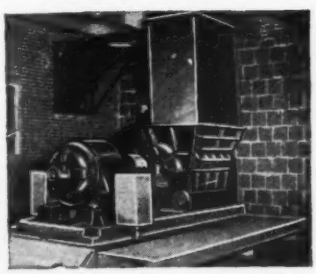
Unique in construction, the interior is divided into three sections. An upper section is the mixing zone. This is divided, by a stilling plate, from an outer annular compartment, which is equal in volume with a central cylindrical uptake.

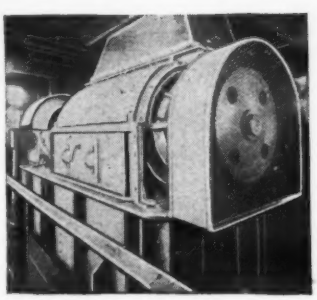
Thorough mixing of chemicals and thorough sedimentation in this tank always insure an adequate volume of properly treated feed water ahead of the filters.

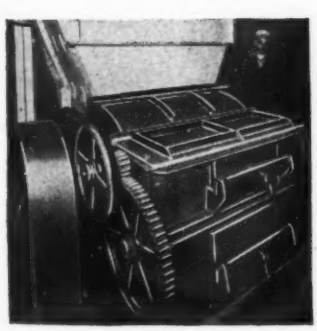
CONSULT INFILCO – FIRST IN WATER AND TRADE WASTE TREATMENT

THERE'S ROOM IN YOUR PLANT for A COMPLETE CRUSHING OPERATION





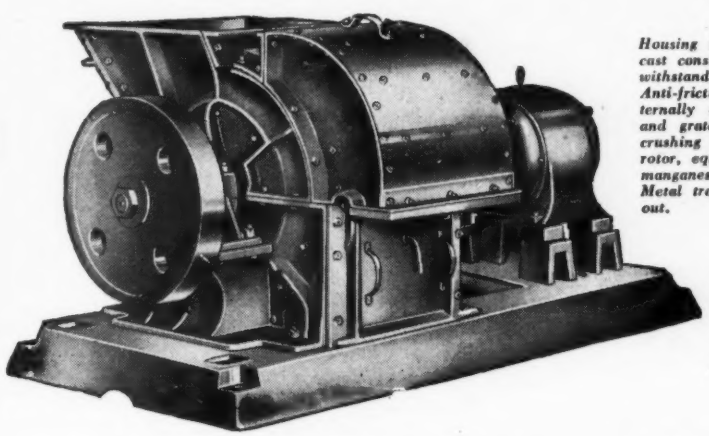




The Compactness of American Rolling Ring Crushers Require Only Minimum Headroom

Designed and built for minimum headroom requirements, the American Rolling Ring Crusher is a compact, high capacity, complete crushing unit that requires no auxiliary equipment and no extra operational or stand-by maintenance labor is required. There is no refuse disposal or extra-picking problem in an American installation.

American Rolling Ring Crushers assure a complete, high-capacity, extremely low-cost crushing operation, uniformly reducing ROM coal to stoker or pulverizer size—handling waste —and rejecting tramp metal for complete safety to mechanical firing devices.



Housing is of massive, high test cast construction—rib-reinforced to withstand enormous crushing strains. Anti-friction type bearings — externally adjustable grinding plate and grate bars. Manganese steel crushing parts and heavy-duty rotor, equipped with multiples of manganese steel shredder rings. Metal trap with convenient clean-out.

Throughout the country in the many power plants with American installations, you'll find efficient coal crushing resulting in efficient firing.

American Rolling Ring Crushers with their patented shredder ring action which *splits coal instead of crushing it* assures uniform sizing. Fines are controlled to a minimum and no oversized is passed. The crushed product is a constant yield of stoker or pulverizer size. The total operating cost of Americans is less than 1¢ per ton. Capacities up to 500 TPH.

Send for bulletin,

"Crushing Coal at Less Than One Cent Per Ton."

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE.
ST. LOUIS 10, MO.

COMPARE MODINE

with any other Unit Heater on the market!

HORIZONTAL DELIVERY

23 Models — the most popular type of unit heater for general industrial and commercial applications. Patented Modine center tappings permit direct-from-pipe-line suspension for low cost, fast installation.

VERTICAL DELIVERY

16 Models — designed for overhead installation, up near ceilings of high bays to clear plant production equipment, or at low levels as in stores and offices. Delivers large volume of air at even temperatures.

NEW POWER-THROW

8 Models — a new type of draw-through horizontal delivery unit heater designed for specialized industrial applications. Powerful, scouring jet action provides "long distance" penetration in hard-to-heat areas.

It's Today's Greatest Unit Heater Value!

COMPARE COST! You pay no more for these great new 1947 Modine Unit Heaters, which give you the newest and finest in unit heater design, plus outstanding construction and performance.

COMPARE APPEARANCE! You get the most beautiful unit heaters ever developed. Styled for today's and tomorrow's interiors; attractive beige gray finish with sparkling chrome trim is protected against rust by Modine Parker-Bonderizing.

COMPARE DESIGN! You can choose from an integrated line with 47 basic capacities for steam and hot water, perfectly coordinated in range of types and sizes, appearance, structural design and performance.

COMPARE PERFORMANCE! You can be sure of the same top quality heating performance, fuel economy, low operating and maintenance costs — which have made Modine Unit Heaters the number one choice of heating engineers for more than 20 years.

COMPARE VERSATILITY! You can now meet varying heat, air delivery, mounting height and location demands of today's complex heating jobs with three distinct types of unit heaters. Use them individually, or in combination with each other!

FREE! SEND FOR NEW COMPLETE CATALOG

Every heating engineer should have this valuable engineering data on the new 1947 Modine Unit Heater Line. Get your copy today!
Modine Mfg. Co., 1830 Racine Street, Racine, Wisconsin.

Modine UNIT HEATERS

Just a Piece of METAL

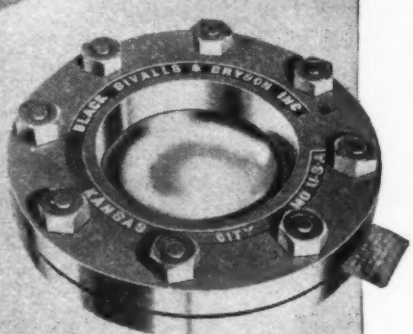
...But IT MAY *SAVE YOUR LIFE*

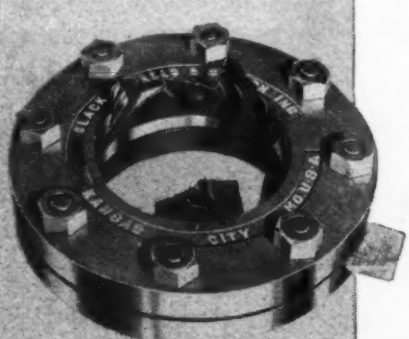
The rupture diaphragm of the B. S. & B. SAFETY HEAD is the "pressure fuse" which will prevent your pressure vessels from blowing up.

It starts life as a flat blank of almost any metal—Aluminum, copper, silver, stainless steel, platinum and a dozen others are used. Then it is given the spherical form which in great measure accounts for its ability to withstand fatigue in service and to burst at the right pressure in time of need.

Specimen discs are regularly burst to assure consistent performance. The specified bursting pressure of each SAFETY HEAD diaphragm is the average of bursting pressures of two or more specimen discs from an adjacent section of the same sheet of metal. The bursting pressure of the SAFETY HEAD Diaphragn is marked on a permanently attached metal tab.

A lot of care goes into turning this little piece of metal into a "life preserver" for your life and property. We believe this function deserves the full measure of our fifteen years of research and know-how—and the success of our efforts is proven by the fact that **no pressure vessel equipped with a SAFETY HEAD has ever burst from over pressure.**





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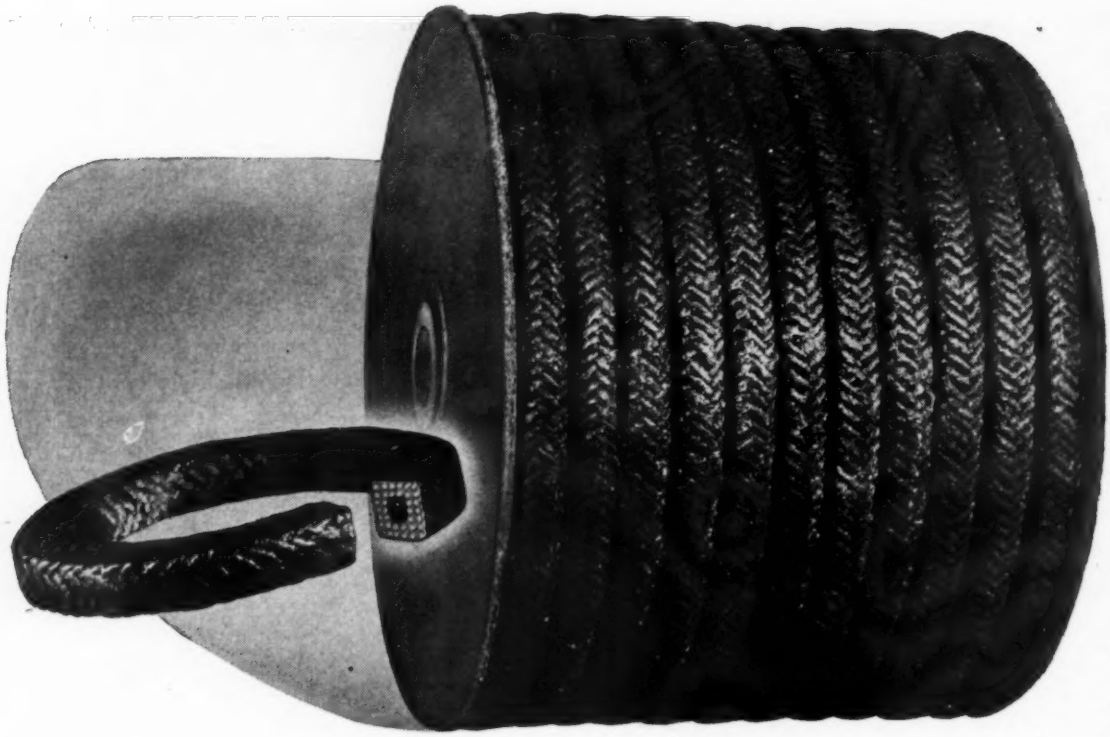

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Here is a typical example of the way in which all R/M packings are designed to meet specific conditions. This packing was created to furnish a tight seal around valve stems and in expansion joints handling super-heated steam or hot gases at temperatures up to 900°F.

It is manufactured by braiding a jacket of Monel wire and pure asbestos yarns over a soft graphite core. The jacket contains a binder that resists high temperature, and the exterior is coated with flake graphite. The graphite core is not affected by heat and allows the packing to change cross section when gland pressure is applied.

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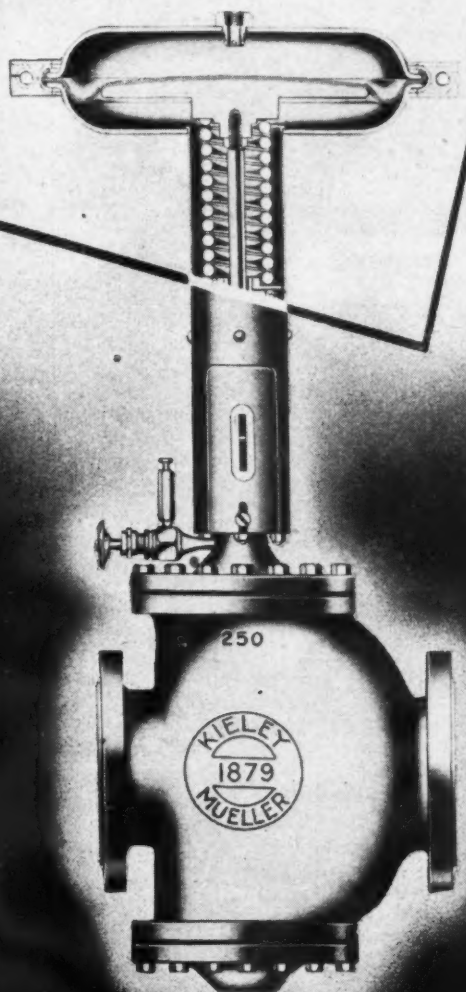
KONTROL MOTOR DIAPHRAGM VALVE



Just two simple quick-acting clamp screws to loosen, and your diaphragm casing is off. Tight-sealing clamp ring eliminates multiple bolts completely. Duo-seal molded diaphragm lips are automatically self-sealing.

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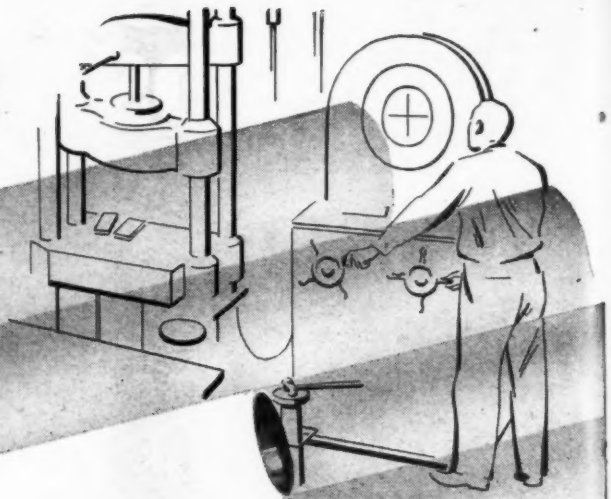

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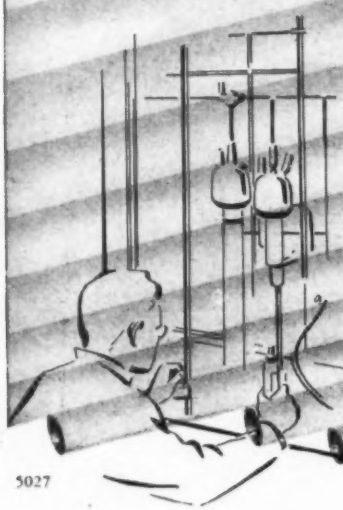

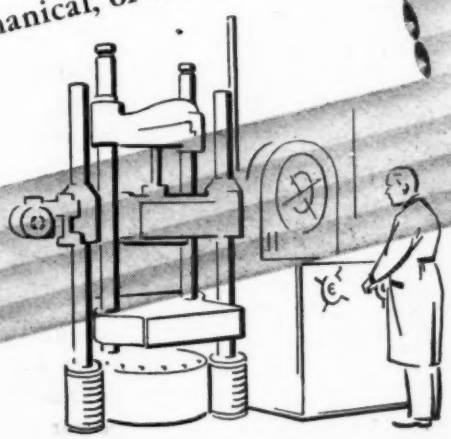

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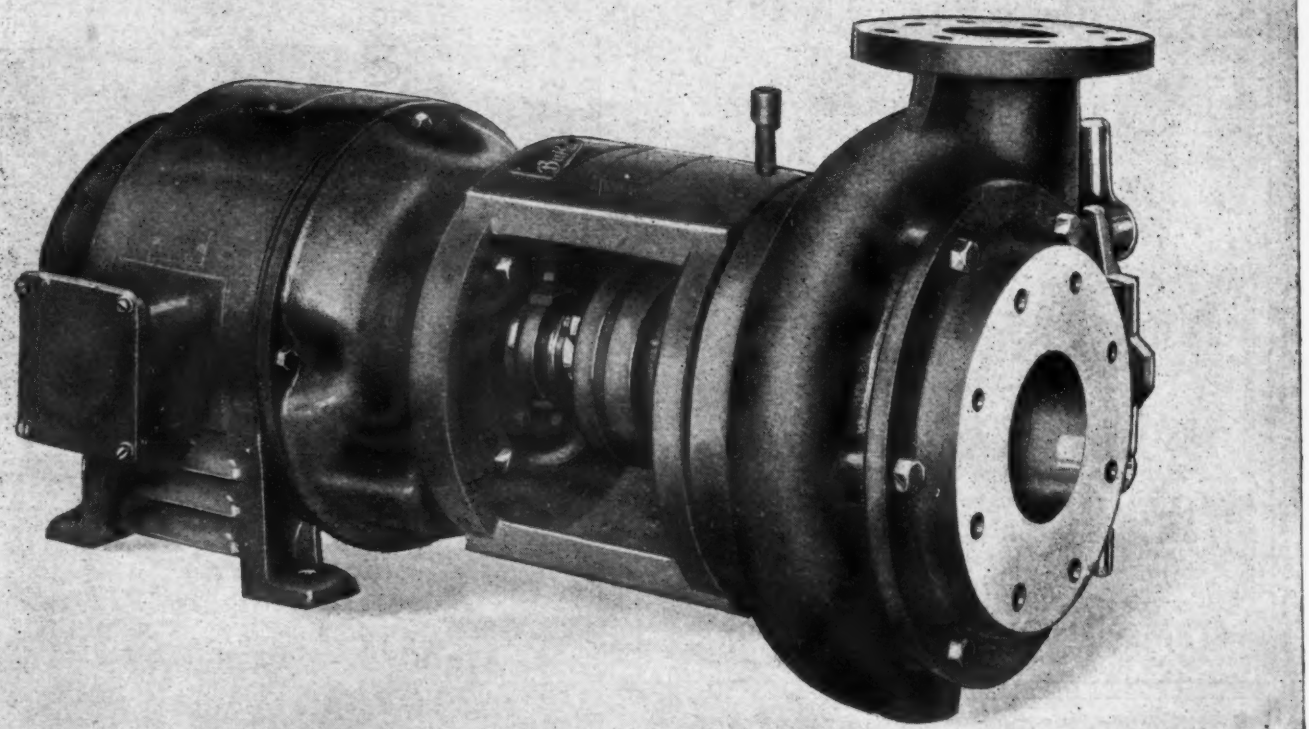

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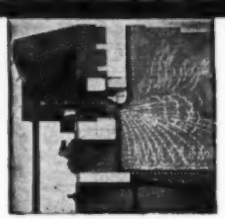

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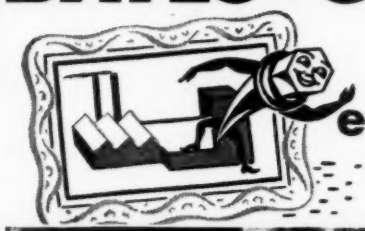
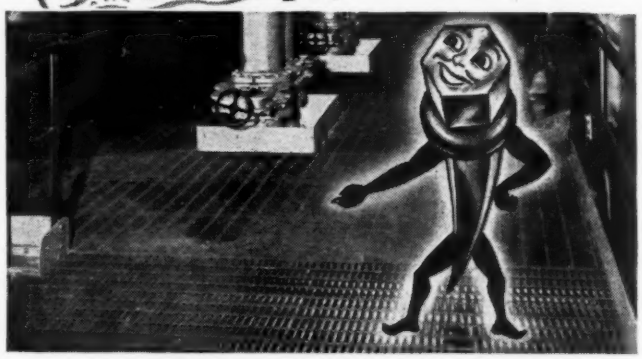
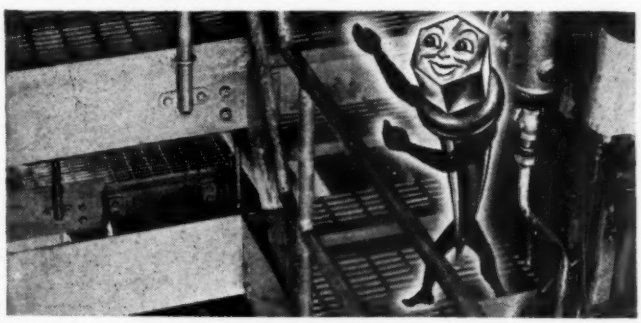




If yours is an application like this—with pipes, installations and stairways cutting into the area— BATES • GRATES will give you neat, safe and strong open steel flooring.



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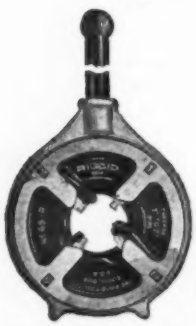

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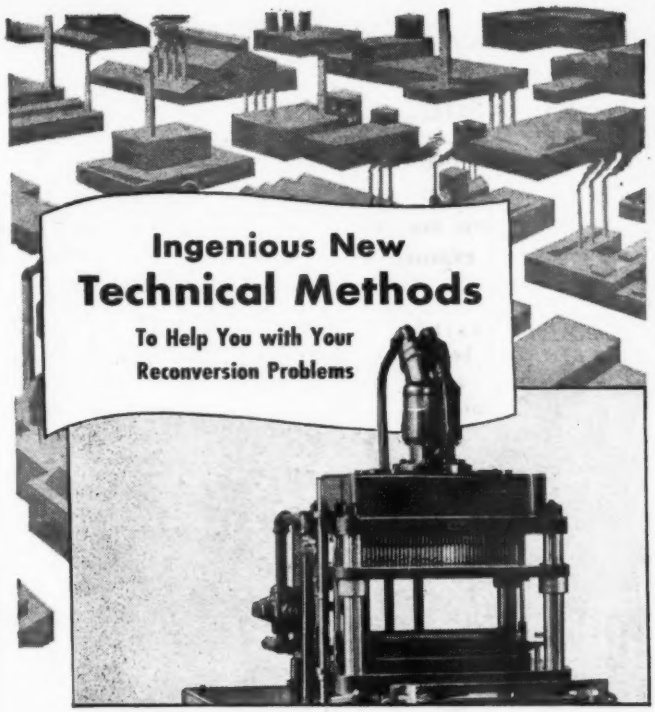

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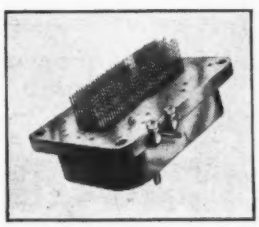

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With this unit all holes are drilled at one pass, and valuable time is saved by the elimination of indexing and extra handling. It may be used on standard drill presses, or furnished as a complete hydraulic machine by the factory.

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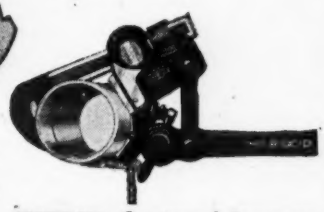

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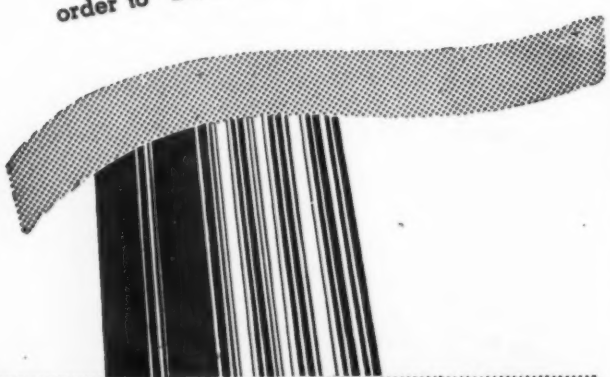

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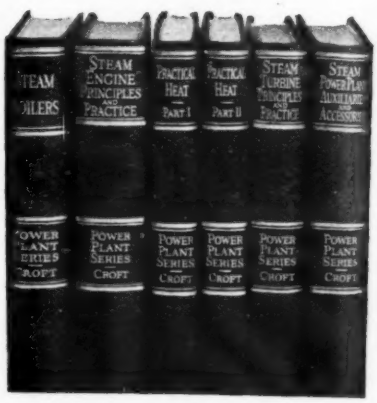
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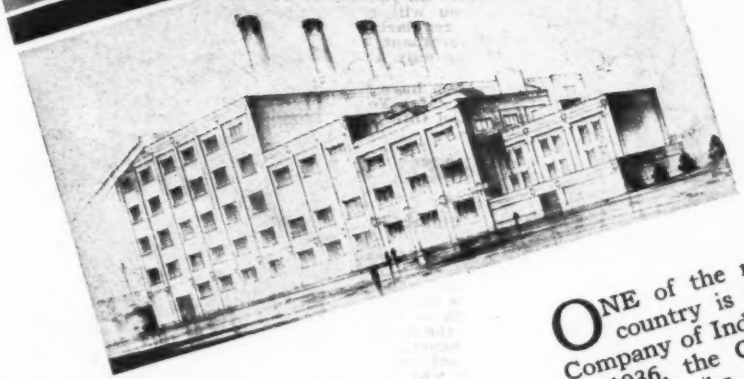

DEAERATORS AT *Indianapolis Power & Light*

ONE of the most progressive utilities in the country is the Indianapolis Power & Light Company of Indianapolis, Indiana. Ten years ago, in 1936, the Cochrane Corporation furnished a 650,000 lb/hr. Deaerator, for Section "K" of the C. C. Perry plant. This Cochrane Deaerator heated the entire boiler feed in Section "K" and completely removed dissolved oxygen. Again in 1940 a 400,000 lb/hr. Deaerator was installed in the Harding Street Plant for Unit #3.

Now, as indicated by the architect's drawing shown at the top of the page, the Perry "K" Station is being expanded and another Cochrane Deaerator of 700,000 lb/hr. shown in the illustration below, is being installed. At the same time another 400,000 lb/hr. Cochrane Deaerator is being installed in the Harding Street station for Unit #4.

Cochrane Water Conditioning Apparatus has been a part of Indianapolis Power & Light Company equipment since 1917.

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PHILADELPHIA 32, PA.

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C. C. PERRY STATION
SECTION "K"

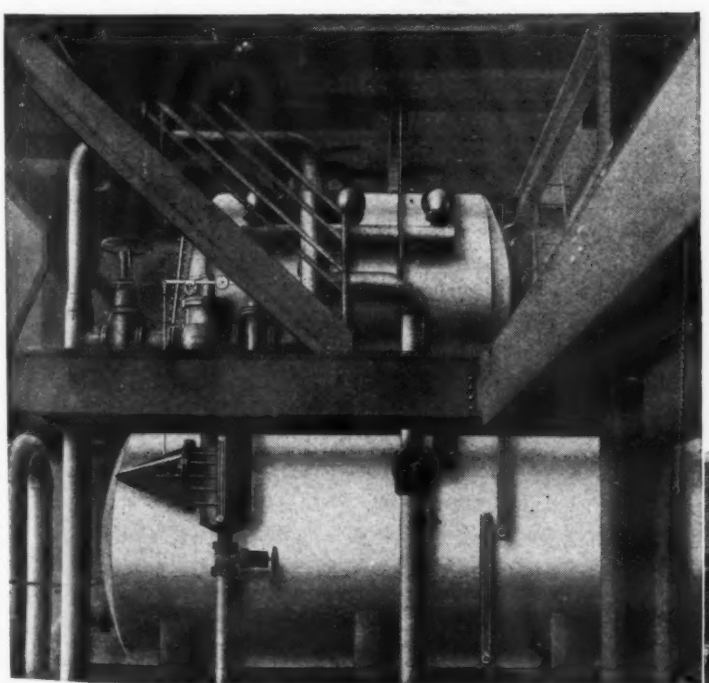
One 650,000 lb/hr. Cochrane Deaerator
Two 400,000 lb/hr. Cochrane Open Heaters

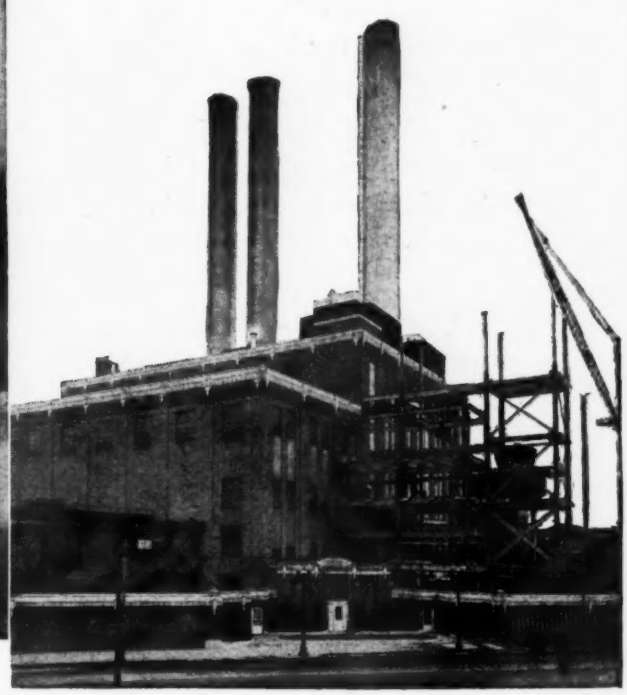
MILL STREET STATION

Two 300,000 lb/hr. Cochrane Open Heaters
One 500,000 lb/hr. Cochrane Open Heater

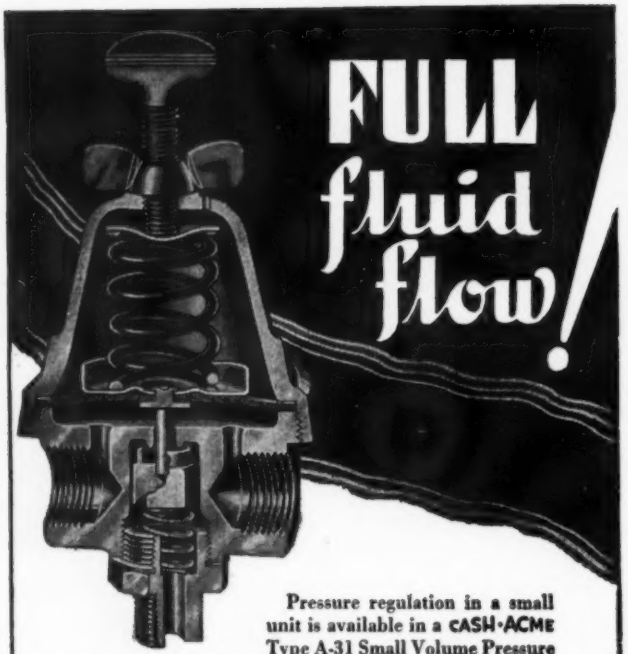
HARDING STREET STATION

Two 350,000 lb/hr. Cochrane Open Type Heaters
One 400,000 lb/hr. Cochrane Deaerating Heater





FULL fluid flow!



Type A-31-3way
¼ Actual Size

Pressure regulation in a small unit is available in a CASH·ACME Type A-31 Small Volume Pressure Reducing & Regulating Valve for Water, Air, Gas, etc.

Complete data on this and other CASH·ACME products is available in our NEW catalog No. D12.

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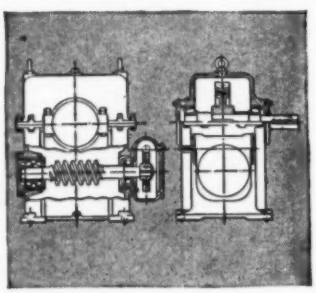
FOR HEAVY GOING



LUBRIPLATE No. 8 possesses an extremely high film strength and is just the correct density for the general run of enclosed gears (speed reducers). It is especially suitable for worm gears and other types carrying heavy loads. Typical of all LUBRIPLATE lubricants, No. 8 has exceptionally long life.

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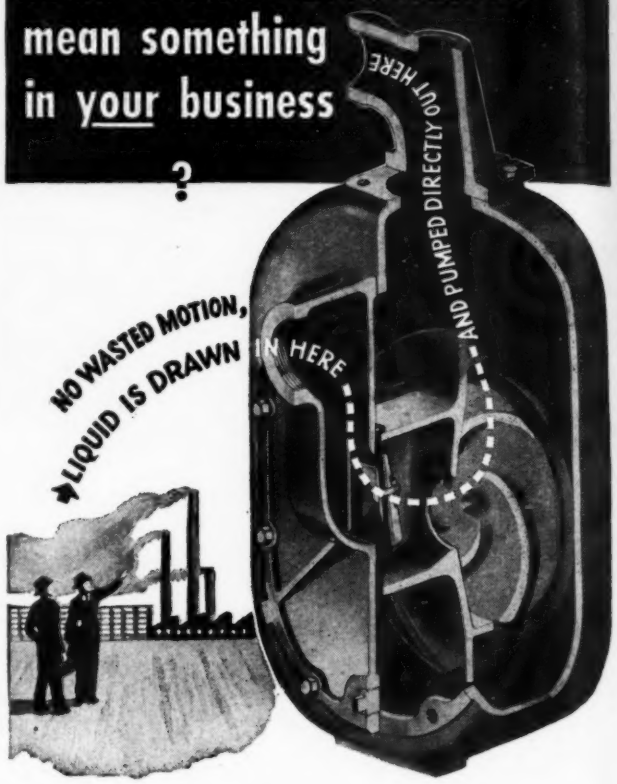

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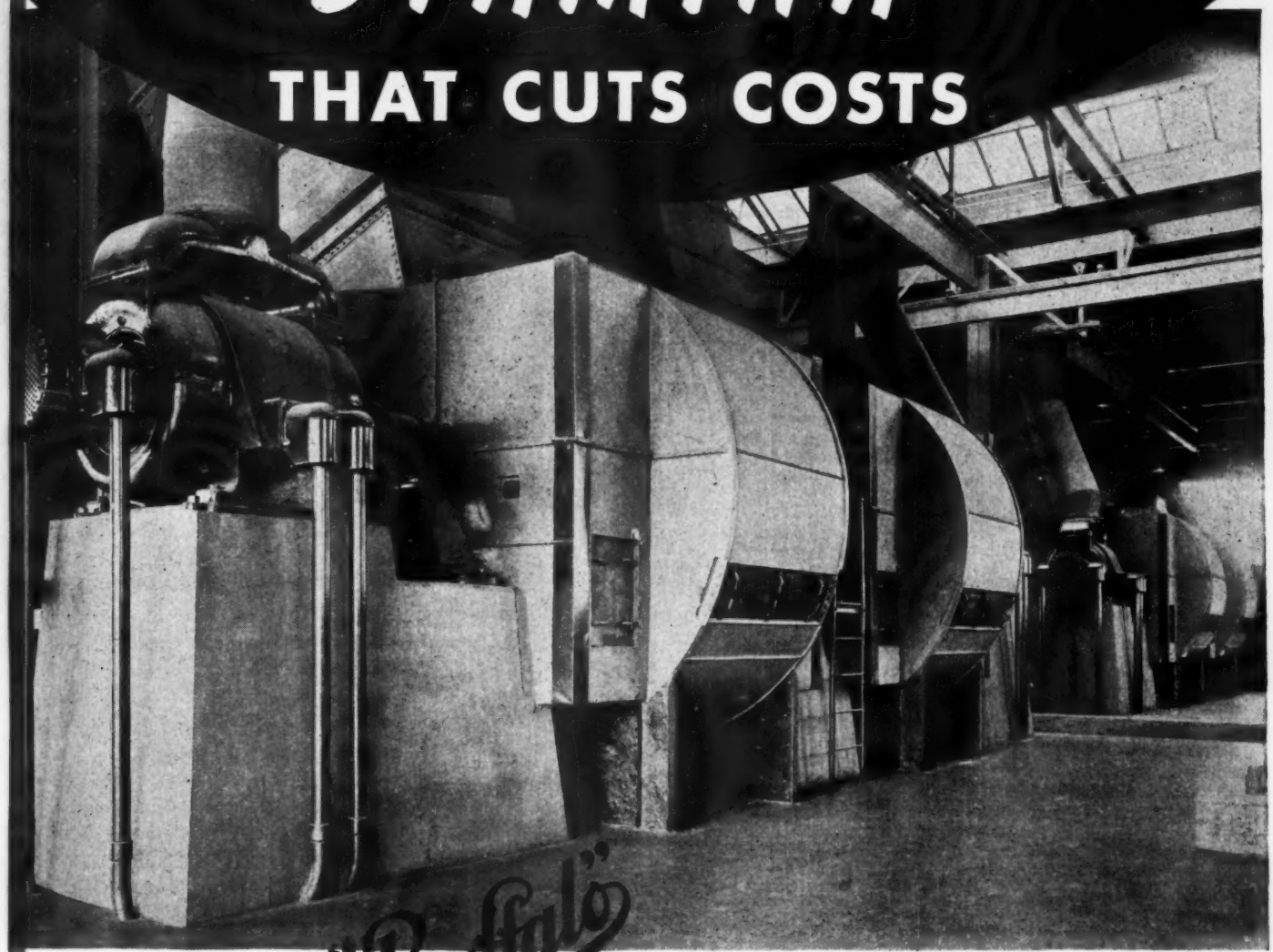

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Two Simple Inventions Offer Important Economies in Condenser Operation

New Fibreclad* Flowrite tube inserts stop condenser tube end erosion, seal tube leaks, prolong life of old tubes, and reduce water friction up to 80%.

New Detectaleak* Tube Tester instantly locates leaking tubes without necessity of dismantling condenser.

* PATENT PENDING

For over 20 years millions of Flowrites, metal belled-end tube inserts, have been used successfully to protect condenser tube inlet ends against erosion and to eliminate expensive shutdowns for tube replacement. A new type insert, called Fibreclad Flowrite, offers many important advantages over other types previously available.

The Fibreclad Flowrite consists of a belled-end unbreakable metal tube, similar to the old Flowrite, with a very thin fibre sleeve shrunk on the outside, as shown in Fig. 2. Installation is very simple, and requires no cement, no special care. After installation, the fibre swells when in contact with water, producing a very tight seal which prevents leakage, even through tubes eroded like those shown in Fig. 1.

The peculiar shape of Fibreclad Flowrites provides a perfect venturi which reduces water friction up to 80%, according to tests conducted at M. I. T.

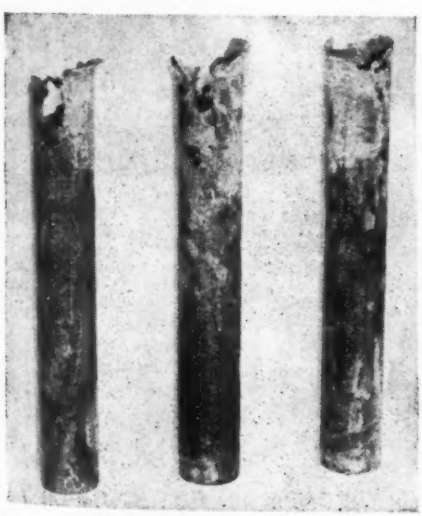


Fig. 1—Three badly eroded condenser tubes cut out of a unit to show condition of tubes which Fibreclad Flowrites can salvage for further service.

Fibreclad Flowrites are available for any size tube, in lengths to suit the erosion problem of the particular unit for which they are ordered.

Detectaleak Tube Tester

Anyone who has gone through the tedious, time-consuming process of weeding out leaking condenser tubes will appreciate a newly invented simple tool called Detectaleak Tube Tester. With this tool leaking tubes can be located instantly without dismantling the condenser.

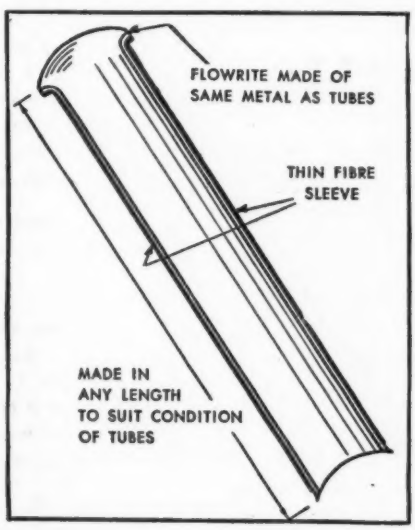


Fig. 2—Cross section of Fibreclad Flowrite showing new fibre sleeve feature.

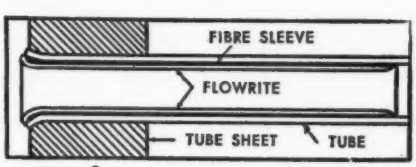
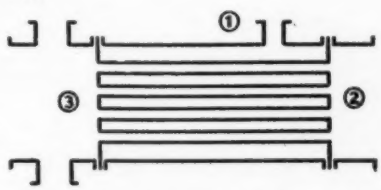


Fig. 3—Fibreclad Flowrites can be used with any type of tube joint.

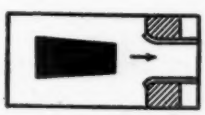
The Detectaleak Tube Tester consists of a rubber body, one end of which is conical to fit into the tube, and the other end is a thin-walled bulb. An air passage connects the bulb with the conical end. A knurled metal sleeve surrounds the body to provide a grip for the hand.

Fig. 4—Detectaleak Tube Tester which instantly indicates a leaking condenser tube.

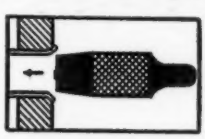
The illustrations below show the simple, effective operation of the Detectaleak Tube Tester.



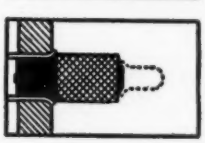
1—With condenser out of service, maintain vacuum in steam space with condenser steam jets.



2—Plug one end of tubes with fibre plugs.



3—Insert Detectaleak Tube Testers in other end of tubes.



4—If Detectaleak bulb is sucked in, tube leaks. Each penetrated tube is located quickly, positively.

The service crew of Condenser Service & Engineering Co., Inc., will conduct tests when you take your condenser out of service over the weekend, or any other time. The Detectaleak Tube Tester is one of many special tools developed by us to save time and labor. You can enjoy the fast, economical service of our highly-trained specialists any time of day or night, anywhere on the continent. All necessary materials are in stock. A wire or phone call will get your job started at once.

For complete details of Fibreclad Flowrites and Detectaleak Tube Testers write, wire or phone

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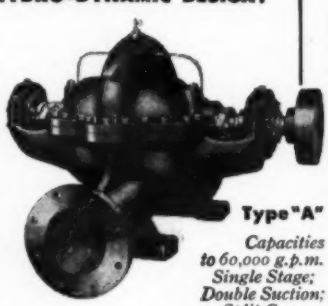

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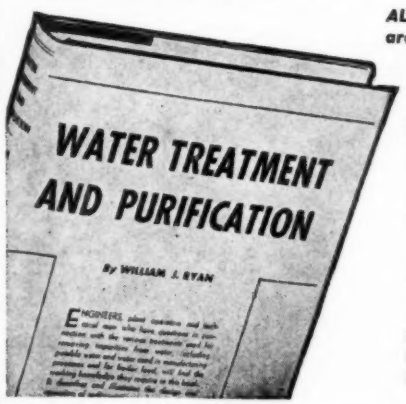

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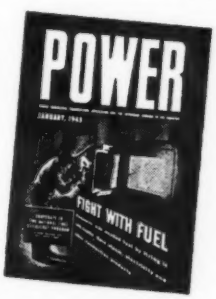

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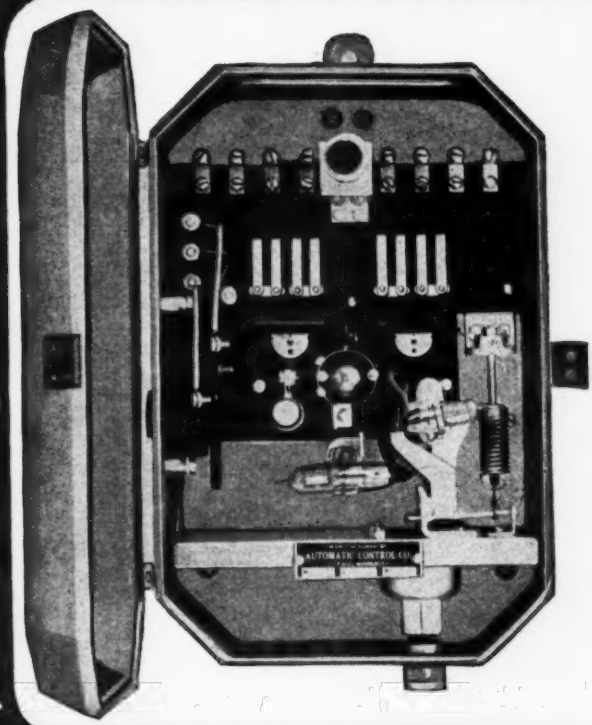

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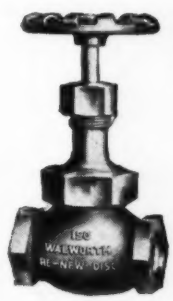
Yes, on tough jobs like these, where brass or copper pipe or copper tubing is used, Walseal bronze valves, fittings, and flanges do a two-fold job.

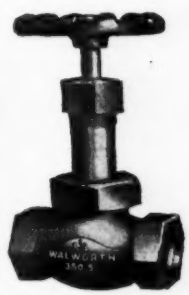
1. They make leakproof, trouble-free connections that are permanent . . . vibration-proof, corrosion-resistant — connections that will not creep or pull apart; that literally join with the pipe to form a "one-piece pipe line."

2. They eliminate the need for maintenance and costly repairs — especially important where lowered operating costs are imperative.

For these reasons more and more piping installations are being made with the modern Silbraz joints, using Walseal products. For complete details on Walseal products, write for a free copy of Walworth Circular 84.



No. 95WS — 150-Pound Bronze Globe Valve with Renewable Disc, Lock-on Disc Holder, and Walseal Ends.



No. 225PWS — 350-Pound Bronze Globe Valve with "500 Brinell" Plug Type Seat and Disc, and Walseal Ends.

Walworth also manufactures a complete line of bronze, iron, and steel valves and fittings. A detailed description of the entire line is included in Catalog 42. Write for your free copy today.

*Patented—Reg. U. S. Pat. Off.

Make it a "one-piece pipe line" with WALSEAL

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

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WHERE TO BUY

Featuring additional products and specialties for power plants

FIRE TUBE MODEL

SAVE COAL

Removal of scale from boiler tubes always saves coal. Use a VIBRATAP TUBE CLEANER for a thorough removal or incrustation. Write for Bulletin V-20.

BRUNT EQUIPMENT CO.
60 S. DIVISION ST. • BUFFALO, N. Y.

End Pump Troubles!

HILL IMPROVED PUMP VALVES

• The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate. Send today for bulletin that tells how to get better pump performance.

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TEST SPEEDS and SAVE at a glance
REVOLUTIONS and FEET per min.
SPEED VARIATIONS
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HIGH TEMPERATURE Refractory Cements
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POWERS TEMPERATURE and HUMIDITY CONTROL

For Industrial Processes, Heating and Air Conditioning Systems, Hot Water Heaters and Shower Baths. Write for Bulletins.
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THE ORIGINAL
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TRIPP METALLIC PACKING CO.
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prevent overloading or operation below peak.
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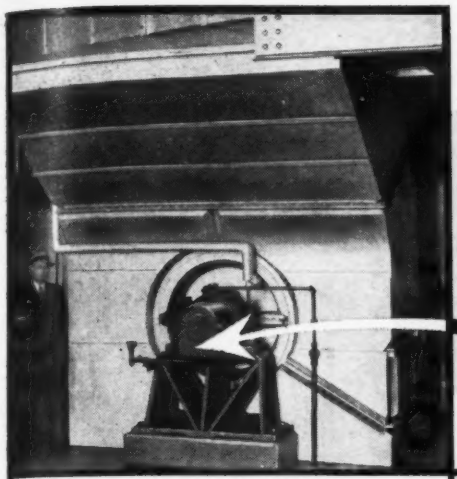


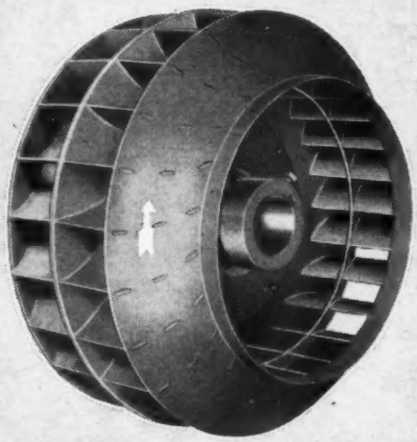
LOW COST FAN* PERFORMANCE STARTS HERE

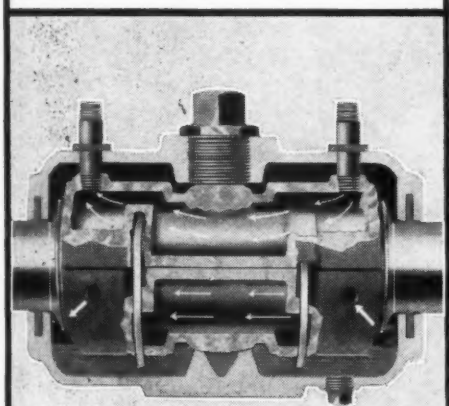
*Use CLARAGE RT's for Induced Draft

(and Other High Temperature Applications)

Extra Heavy, Double Width Wheels →

Note absence of rivets and angles for self-cleaning, streamline service. Radial tip, one-piece blades WELDED in place are rigidly held by a deep reinforcing band. Accurately machined hubs — no brace rods necessary. All wheels both statically and dynamically balanced.





← Over-Size, Water-Cooled Bearings

Cooling water circulates through each half of bearing sleeve independent of the other. No joints or gaskets — **water can't leak into bearing oil.** Thrust collars (forged, turned and ground) an integral part of shaft. Seals insure dust-proof and oil-tight bearings.

Built into every Clarage Type RT Fan is a PRECISION STRENGTH which more than answers the punishing demands of mechanical draft and other tough air-handling jobs.

The RT fan wheel is constructed to insure trouble-free operation at tip speeds as high as four miles a minute.

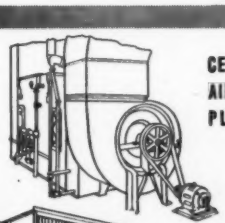
. . . And because these RT Fans must often combat high temperatures — 700° F. and higher — Clarage furnishes specially designed, water-jacketed bearings. Here again, a feature that adds up to much longer service life!

But this ability to out-perform and out-last is not a monoply of the Type RT Fan, for it is equally characteristic of all other Clarage equipment!

Whatever your air-handling, or conditioning problem, call on our engineering facilities for recommendations. No obligation, of course!

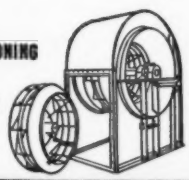
SOME OF OUR OTHER PRODUCTS

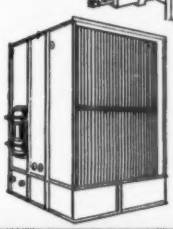
UNIT HEATERS



CENTRAL STATION AIR CONDITIONING PLANTS

AIR CONDITIONING AND VENTILATING FANS





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CLARAGE

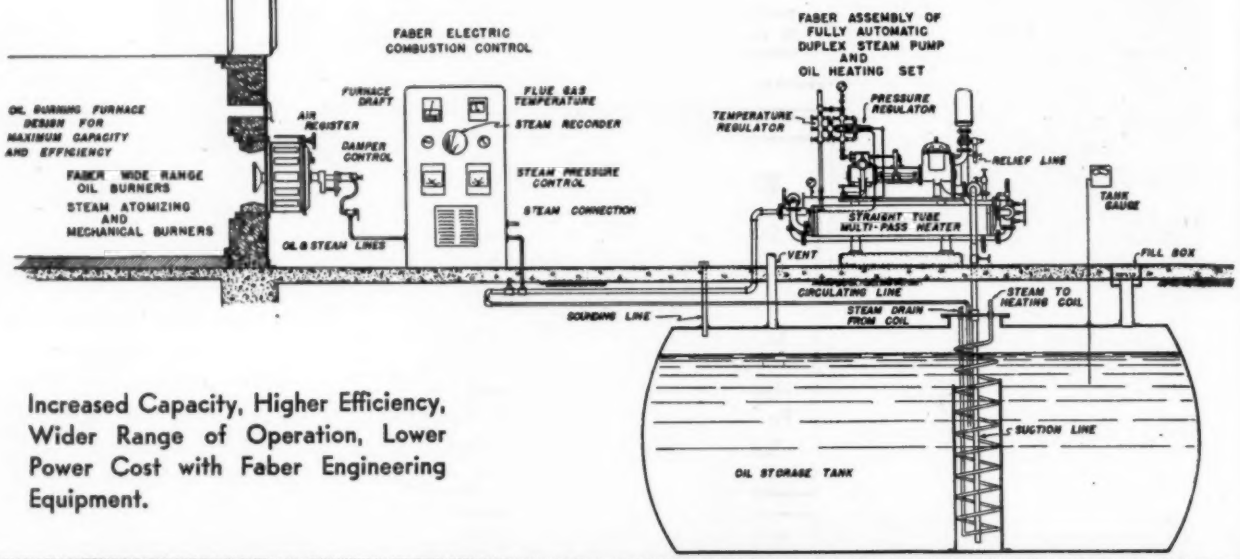
FAN COMPANY

Kalamazoo, Michigan

APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

PERFORMANCE PROVED

FABER FUEL OIL BURNING SYSTEM

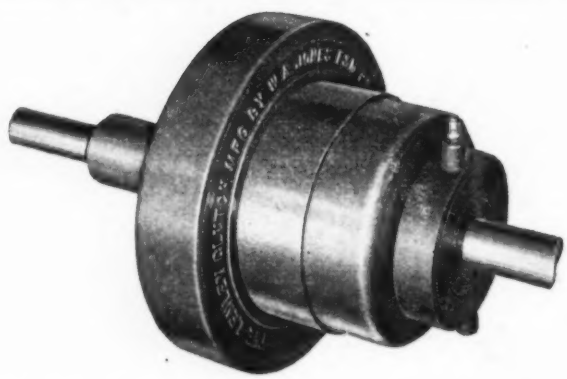


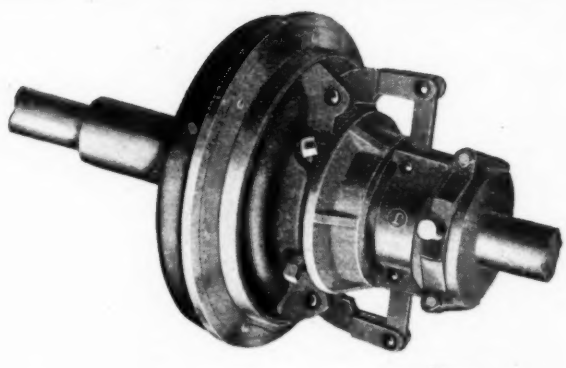
Increased Capacity, Higher Efficiency, Wider Range of Operation, Lower Power Cost with Faber Engineering Equipment.

FABER ENGINEERING CO.

PHILADELPHIA 34, PA.

JONES-LEMLEY FRICTION CLUTCHES





JONES-LEMLEY friction clutches are built for a broad range of shaft sizes and ratings in both enclosed and open types for sleeve and coupling work. In addition they are available in a line of Jones-Lemley friction clutch pulleys. This clutch modification is also used for gears, V-belt sheaves, sprocket wheels, etc. Sizes, ratings, dimensions, prices and other data are contained in Bulletin No. 60. Your request will bring a copy.

W. A. JONES FOUNDRY & MACHINE CO., 4423 Roosevelt Rd., Chicago, Illinois

Jones

HERRINGBONE—WORM—SPUR—GEAR SPEED REDUCERS • PULLEYS
CUT AND MOLDED TOOTH GEARS • V-BELT SHEAVES • ANTI-FRICTION
PILLOW BLOCKS • FRICTION CLUTCHES • TRANSMISSION APPLIANCES

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(Not available for equipment advertising)
15 cents a word, minimum charge $3.00. (See ¶ on Box Numbers.)
POSITIONS WANTED (full or part-time individual salaried employment only), ½ the above rates.
PROPOSALS, 75 cents a line an insertion.

INFORMATION

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $8.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. P.

NEW ADVERTISEMENTS received by November 13th will appear in the December issue, subject to limitation of space available

WANTED

DESIGN & DRAFTSMEN

Wanted by midwest firm of engineers men qualified for design and drafting on power plant work, including structural, piping, breechings, general layout work, etc.

P-195, Power
520 North Michigan Ave., Chicago 11, Ill.

POSITIONS VACANT

WANTED: MACHINE designer. Centrifugal Pump layout experience preferred. Apply—Dean Brothers Pumps Inc., Indianapolis 7, Indiana.

TECHNICAL GRADUATES (especially chemical, electrical) under 30, returned from military services have excellent opportunity for permanent place with nation-wide engineering organization. After training period, work as junior engineer will include traveling for consultation among leading industrial plants. Enclose photo when answering. P-192, Power, 330 W. 42nd St., New York 18, N. Y.

EMPLOYMENT SERVICE

SALARIED POSITIONS $2,500-$25,000. This thoroughly organized confidential service of 36 years' recognized standing and reputation carries on preliminary negotiations for supervisory, technical and executive positions of the calibre indicated, through a procedure individualized to each client's requirements. Retaining fee protected by refund provision. Identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

ELECTRICAL ENGINEER B.S. (E.E.) 29, married. 2½ years Public Utiliuty exp. Metering, Standardization, Relay, Remote Control, Rates, etc. 4½ years Army Officer, Signal Corps. Diesel Elec. Installation and Power Supply. Radio and Antenna. Good gen. knowledge. New York area preferred. PW-204, Power, 330 W. 42nd St., New York 18, N. Y.

17 YEARS Power Plant experience. Desire position anywhere in the U.S. or foreign Co. Had experience in coal fired plants, Gas and oil, also high pressure plant. PW-205, Power, 68 Post St., San Francisco 4, Cal.

QUALIFIED either as Sales or Personnel Executive; Entirely familiar with qualifications of sales, shop or Technical help needed. Background M.I.T. Mechanical Engineer, long experience Sales Engineering, Pumps, Diesel Engines. Extensive acquaintance large Marine and Industrial Manufacturing concerns on Atlantic Seaboard. PW 206, Power, 330 W. 42nd St., New York 18, N. Y.

VETERAN returned to college. Age 29. Will graduate January, 1947 B.S. Mechanical Engineering. Desire position with engineering firm or consultant in power plant or process design. 3 years engineer officer large turbine driven naval vessel. 1½ years draftsman for midwest engineering firm on process and piping design. Prefer location either Mid-west or vicinity Los Angeles. Available February. PW-207, Power, 520 North Michigan Ave., Chicago 11, Ill.

MARINE ENGINEER: Naval Lieutenant—Age 27—Married—Over 9 years practical experience personnel administration operation and maintenance turbo-electric, diesel-electric and turbo-geared marine installations from 180,000 H.P. to 3750 H.P. Experience includes Chief Engineer, diesel-electric and turbo-geared plants. Desire to leave Naval Service and settle down to permanent position in industrial or utility power plant. Location in Pacific Northwest preferred but will consider other locales. Can furnish past records and references. PW-209, Power, 68 Post St., San Francisco 4, Cal.

MASTER MECHANIC, 35, married, Member of A.S.M.E. Experienced in various shops, heavy equipment, mining milling, marine, construction, rehabilitation, preventative maintenance programs. Box 231, McIntyre, George. Jim Tierman.

WANTED

STRUCTURAL DRAFTSMEN

Experienced In

Steel and Reinforced Concrete For Industrial Plants and Commercial Buildings

Also

MECHANICAL DRAFTSMEN

Experienced In

High and Low Pressure Piping For Power Plants and Industrial Plants

WESTCOTT & MAPES, INC.
New Haven, Connecticut

MECHANICAL ENGINEERS

Mechanical engineers (3), technical graduates, thoroughly experienced and competent engineering and design steam power plants, high pressure and temperatures, varied fuels, coal and ash handling systems, etc. Ability consult and advise with principals on fundamental features and supervise group engineers execution details. Position with well established engineering firm of consulting engineers, location New York City. Salary $7500 annum and up depending on qualifications. Letter should give full particulars, age, education, experience.

P-199, Power
330 West 42nd St., New York 18, N. Y.

MAINTENANCE ENGINEER

Take full charge of repair and rebuilding textile dyeing equipment. Excellent opportunity for individual with good background and experience.

P-197, Power
330 West 42nd St., New York 18, N. Y.

WANTED

MECHANICAL ENGINEER

Technical graduate, thoroughly experienced and competent in engineering and design steam power plants large and small. Ability consult and advise with principals on fundamental features and supervise group engineers execution details. Position with well established engineering firm of consulting engineers, location New York City. Experienced with plants for foreign countries desirable. Knowledge foreign language not essential. Salary commensurate with experience. Letter should give full particulars, age, education, experience.

P-200, Power
330 West 42nd St., New York 18, N. Y.

WANTED

MECHANICAL ENGINEER

Experienced in Steam Power Plant design for Industrial Plants

WESTCOTT & MAPES, INC.
New Haven, Connecticut

DRAFTSMEN

DESIGNERS AND CHECKERS
with experience on
Structural Steel and Concrete
Process Piping
Pressure Vessels

The Boston office of E. B. Badger and Sons Co., internationally famous chemical engineering organization, offers qualified men well-paying positions. This is a fine opportunity for men who would enjoy working in congenial surroundings and with pleasant cooperative associates. A personal interview can be arranged in your city. This is not a temporary position. Write, giving full details of background and experience, salary wanted, etc., to

Mr. William M. Rose, Personnel Director
E. B. Badger and Sons Co.
75 Pitts Street, Boston, Mass.

WANTED

ASSISTANT PLANT SUPERINTENDENT

Privately owned electric utility in Middle West wants assistant plant superintendent. Under 35, graduate engineer, experienced in operation and maintenance of moderate to medium high pressure steam generating plants. Basic knowledge of water treating, combustion, thermodynamics, electricity desirable. Must have good executive ability.

Write giving photo, salary expected, and full particulars of education and experience. Outline in brief details of work since graduation (including military service, if any) giving duties and responsibilities in each instance. Give references, and state if present employer may be used as a reference.

P-195, Power
520 North Michigan Ave., Chicago 11, Ill.

Additional Employment & Business Opportunity Advertising on page 304

WANTED

MANUFACTURER'S AGENT

Old, established British firm of repute, manufacturing a special scale solvent (non-poisonous) is desirous of contacting American Sales Agents interested in distributing their product throughout the United States. All applications will be considered in privacy.

RW-198, Power
330 West 42nd St., New York 18, N. Y.

WANTED

Sales Representatives

Have a few good territory openings for aggressive sales representatives. An old established line of plastic insulation that has been proven successful on all types of boilers, boiler-room equipment, tanks, pipes, furnaces of all types, open hearth, reheat, etc. The line is well advertised and backed by an old, well-financed corporation. This is a real opportunity. State experience and territory wanted. Address

RW-162, Power
520 North Michigan Ave., Chicago 11, Ill.

Let *Us* Represent *You*

Established organization of manufacturers' representatives with proven record of results, having headquarters in Cleveland, wishes to obtain representation of one or two additional manufacturers of heating or power plant equipment for Northeastern Ohio territory. Would prefer steam traps, pressure gauges, thermometers, packings or similar lines.

RA-202, Power
330 West 42nd St., New York 18, N. Y.

FOR SALE

BOILER PLANT EQUIPMENT

4—250 H. P. 1—326 H. P.

B&W Boilers, Underfeed Stokers

Forced Draft Fans Motor Driven

Copes Feedwater Regulators

Steel Smoke Stack 54"x140'

Duplex Steam, Outside Packed Plunger

Boiler Feed Pump 14"x8"x18"

750 H. P. Closed Feedwater Heater

1,000 Gallon Steam Underwriters Fire

Pump 18"x10"x12"

GRANITEVILLE COMPANY
Graniteville, S. C.

Lines of Industrial EQUIPMENT wanted for MARYLAND

By a well-organized Sales, Engineering and Service organization. In the past 18 months we have sold and installed 30 High Pressure Boilers (22 oil-fired, 4 stoker-fired, and 4 hand-fired) of various makes, totaling 2400 H.P. We are also interested in distributorship for a gas-fired boiler line and Return Systems.

P. O. Box 1232 **Baltimore 3, Md.**

1—Nordberg Uniflow 150 H.P. high efficiency engine, 1938, No. 31420, direct connected to:
Crocker-Wheeler D.C. Generator, type CCD, size 139-D, 225 R.P.M., 250 volts, 500 amps, No. 747545, 125 K.W., continuous at 40°C.

1—Filer-Stowell Corliss Engine, 150 H.P., 1913, overhauled 1942, direct connected to:
Crocker-Wheeler D.C. Generator, type CCD, size 209-D, 125 R.P.M., 250 volts, 500 amps, No. 141860, 125 K.W.

1—Waukesha engine run on city gas. Can be run on gasoline. Model VIII—4x5, No. 107843, governor speed 1200 R.P.M., April 1927. Direct connected to:
Kohler Co. D.C. Generator, 10 K.W., 1200 R.P.M., 230 volts, 46 amps.

MILWAUKEE LACE PAPER CO.
1306 E. Meinecke St. Milwaukee, Wisconsin

ATTENTION

SALES MANAGERS

A New England Industrial Sales organization with salesmen calling on the Industrial, Marine, and Power Industries desires an additional line. Are you represented in New England, if not, write

RA-201, Power
330 West 42nd St., New York 18, N. Y.

Compulsory retirement of owner necessitates sale of valve manufacturing business established in 1919. Machinery and patterns for making internationally known heavy regrinding type of valve, both screwed and flanged, in bronze, cast steel and iron. Plant in full production at present time. Real estate on which plant located included in sale. Purchase price approximately $100,000. Will deal only directly with purchaser—no brokers. Reply

BO-208, Power
330 West 42nd St., New York 18, N. Y.

SALES REPRESENTATIVE

Registered Engineer Calling on some 2000 plants in Illinois and greater Chicago area. Well acquainted in the power plant field. Desires one additional high-grade product for this territory.

RA-196, Power
520 North Michigan Ave., Chicago 11, Ill.

FOR SALE

STOKER

1—New Detroit Roto Stoker, three 27" rotors, 13x9' stationary grates, complete. Purchasing power, reason for selling.

GOODMAN LUMBER COMPANY
Goodman, Wisconsin

AVAILABLE

SALES ENGINEER

Wide acquaintance among engineering executives western Penna., West Virginia, eastern Ohio. Mechanical engineering graduate. Many years experience power plant equipment. Will locate anywhere east of Chicago. Full details and sales record on request.

SA-203, Power
330 West 42nd St., New York 18, N. Y.

METERS FOR SALE

4 Honeywell Minneapolis Brown Instrument Steam Meters at Sacrifice

ALPER MANAGEMENT
65 Madison Ave. N. Y. C.
Lexington 2-7977

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—the Searchlight Section of the McGraw-Hill publications is at your service for bringing business needs or "opportunities" to the attention of men associated in executive, management, sales and responsible technical, engineering and operating capacities with the industries servetod by McGraw-Hill publications.

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DIRECT TO PRINCIPALS.

WE ACT IN OUR OWN BEHALF AND IN THE STRICTEST CONFIDENCE

CASH

IN LARGE SUMS AVAILABLE FOR QUICK . . . .

PURCHASE

(OF ASSETS OR CAPITAL)

- *Industrial Plants*
- *Manufacturing Divs.*

OR UNITS

Address:
Box 1234
147 W. 42 St., N. Y. 18, N. Y.

STOKER

One (1) BROWNELL, Type C-150, screw type stoker complete, 5 H.P. AC motor, capacity 750 lbs. p/hr. continuous load, 900 lbs. p/hr. peak load, hopper capacity 1200 lbs. Excellent condition.

WESTBORO REALTY COMPANY
565 West End Avenue, New York 24, N. Y.

FOR SALE—USED EQUIPMENT

1—24"-125# Standard Walworth Flanged Gate Valve IBBM, 21-¼" F to F
4—ADSCO Rotary Steam Meter size 12000
1—Cadillac Condensation Steam Meter, size F, 6500#
1—ADSCO Rotary Steam Meter size 6000
Purchasing Department—Kodak Park Works
EASTMAN KODAK COMPANY
ROCHESTER 4, N. Y.

WHEN YOU BUY USED EQUIPMENT LOOK FOR THIS SEAL OF VALUE

JLHCo

The Hemphill Seal assures you that the Hemphill Equipment you buy is *good* equipment. When we rebuild and test, it is done under the supervision of our own Electrical Engineers. And we guarantee its service. Remember these facts before you invest your money.

HEMPHILL EQUIPMENT IS GUARANTEED

MOTOR GENERATOR SETS

1—300 K.W. G.E. 275V, . unit syn. motor 2200 volt, 720 RPM.
1—150 K.W. Westinghouse 125 V. Sq. Cg. 220 V. . phase 900 RPM.
1—125 K.W. Crocker-Wheeler 125 V. Sq. Cg. 2300 V. 3 phase, 1200 RPM.
1—80 K.W. Crocker-Wheeler 3 unit 125 V. Syn. Motor, 220 V.
6—17 K.W. Allis-Chalmers 3 unit 125 V. Sq. Cg. 220 V. 1800 RPM.

ENGINE GENERATOR SETS

1—150 KVA. G.E. Ames Unaflow Engine, non-condensing.
1—120 K.W. Gasoline driven G.E. with Van Bierck Engine.

TURBO GENERATORS

1—600 KW. Terry dual bleeder condensing Turbine only.
1—300 K.W. 125/250 Volt, General Electric non-condensing.
1—300 K.W. General Electric, 3 phase, 60 cycle, 220 volt cond.
1—30 K.W. 135 volt, Allis-Chalmers, non-cond.

TRANSFORMERS

1—1000 KVA. Auto Transf. 4150 V. 3 Ph. 4 wire to 2406 V. 2 Ph.
3—100 KVA. Westinghouse 11430/250 volt.
3—100 KVA. General Electric 13200/250 volt.
3— 75 KVA. General Electric 13500/750/440 volt.
2— 50 KVA. Pittsburgh 7500/15000 V. 110/220 v.

ALTERNATORS

1—500 K.W. 3600 RPM. 600 volt, General Electric D.C. exciter.
1—200 KVA. 3600 RPM. 240 volt, Allis-Chalmers D.C. exciter.
1—180 KW. 514 RPM. 550 volt, Westinghouse.
1—165 K.W. 514 RPM. 2400 volt, Electric Mach.
1—62½ K.W. 3600 RPM. 230 volt, Allis-Chalmers.
1—40 K.W. 1800 RPM. 550 volt, General Electric.
1—35 K.W. 1200 RPM, 240 volt, Columbia Electric D.C. exciter.
1—31.3 KVA. 1200 RPM. 120/280 volt, American D.C. exciter.
1—12.5 KVA. 1200 RPM. 240 volt, Westinghouse, D.C. exciter.

MOTORS—VARIABLE SPEED

230 VOLT

2—200 H.P. 425/212 RPM. General Electric MPC.
1— 40 H.P. 755/1000 RPM. Sprague LC.
1— 30 H.P. 400/120 RPM. General Electric RC-204
1— 25 H.P. 650/2200 RPM. Westinghouse SK1110L.
1— 25 H.P. 500/1500 RPM. General Electric RF-12
1— 25 H.P. 400/1200 RPM. Westinghouse SK
2— 25 H.P. 300/900 RPM. Electro Dynamic.
1— 15 H.P. 300/1200 RPM. General Electric RLC-2024
1—13/18 H.P. 350/1200 RPM. Electro Dynamic.
3—11½ H.P. 500/1500 RPM. Westinghouse.
1—7½/10 H.P. 500/1500 RPM. Reliance.
1—6/7.5 H.P. 450/1800 RPM. Crocker-Wheeler CMC.
1—5 H.P. 500/1500 RPM. Reliance.
1—5 H.P. 600/1200 RPM. General Electric LC.
1—5 H.P. 450/1800 RPM. Crocker-Wheeler CM.
1—5 H.P. 400/1600 RPM. Diehl K6.
1—5 H.P. 225/900 RPM. Electro-Dynamic.

MOTORS 3 PHASE 60 CYCLE

SLIP RING

1—500 H.P. 500 RPM. Lincoln 440 volt.
1—350 H.P. 200 RPM. General Electric MT-424 440 volt.
1—225 H.P. 1800 RPM. General Electric I-L 220 volt.
1— 75 H.P. 900 RPM. General Electric ITC 220 volt.
1— 40 H.P. 1150 RPM. Cont. Electric SA85 220 volt.
1— 40 H.P. 1130 RPM. General Electric Mt. 2200 volt.

MOTORS 3 PHASE 60 CYCLE

SQUIRREL CAGE

1—200 H.P. 1200 G.E. 1K, 2200.
1— 90 H.P. 380 RPM. Crocker-Wheeler 550 volt.
1— 75 H.P. 600 RPM. Westinghouse 550 volt.
2— 50 H.P. 900 RPM. Fairbanks-Morse H, 220 volt.
2— 25 H.P. 1800/1200/900/600 U. S., 44 volt, 3 phase.

D. C. GENERATORS

1—300 K.W. 250 V. G.E. MPC 1000 RPM.
2—250 K.W. 250 V. Crocker-Wheeler Gen. 1200 RPM.
1— 75 K.W. 250 V. Westinghouse 260 RPM.
1— 50 K.W. 115 V. Westinghouse 1200 RPM.
2—31.25 K.W. 125 V. Westinghouse 1400 RPM.
2— 20 K.W. 50 V. G.E. 1800 RPM.

MOTORS D. C.

230 VOLT

2—450 H.P. General Electric MPL 250 volt, 400 RPM.
1—250 H.P. 750 RPM. Electro Dynamic 230 volt.
1—125 H.P. 1725 RPM. General Electric RC-230 volt.
1— 75 H.P. 575 RPM. General Electric C230 volt.
2— 50 H.P. 700 RPM. Crocker-Wheeler CM 230 volt.
2— 30 H.P. 1150 RPM. General Electric RC-31 230 volt.
1— 30 H.P. 1100 RPM. General Electric RC-12 230 volt.
1— 30 H.P. 750 RPM. General Electric RC-14 230 volt.
1— 30 H.P. 625 RPM. General Electric C 230 volt.
1— 25 H.P. 600 RPM. Westinghouse SK 230 volt.
1— 20 H.P. 800 RPM. General Electric RC 12 230 volt.
1— 15 H.P. 350 RPM. Diehl G-312 230 volt.

SYNCHRONOUS MOTORS

1—500 KVA. G.E. 900 RPM. ATI 4150 V. D.C. exciter.
2—160 H.P. Elec. Mach. 1800 RPM. 220 V. DC. exciter.
1—100 H.P. G.E. type TS, 600 RPM. 440 volt D.C. Exciter.
1—75 H.P. 1200 RPM. ATI 220 V. 3 phase.
2—50 H.P. G.E. 100 RPM. TS 220 V.
1—50 H.P. G.E. 1800 RPM. ATI 20 V. D.C. exciter.
1—35 KVA. G.E. 1200 RPM. ATI 2200 V. D.C. exciter.
1—20 H.P. Westinghouse 1800 RPM. 220 V. .8 P.F.

FREQUENCY CHANGERS

1—7½ K.W. 15 KVA 50% P.F. 1800 RPM 215 V. 270 Cy. C.W. Westinghouse.
2—15 K.W. G.E. Type MM, 270 cy.

VERTICAL MOTORS

1—75 G.E. Vert. Solid Shaft 1200 RPM. 220 S.R.
1— 60 Westinghouse Solid Shaft 900 RPM. 200 S.R.

MISCELLANEOUS

2—2100 Gallon Pumps Dayton-Dowd 100 foot head.
4—12,000 GPM. 21' head Axial Flow Vertical Pumps.

JLHCo

THIS SEAL IS YOUR GUARANTEE

"FOR POWER"

J. L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

PHONE NEW JERSEY—UNION 3-2600

2 POINTS TO POUND ON!

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WE SPEND OUR MONEY FIRST — SO

2 IT HAS TO BE GOOD . . .

and Belyea "RE-NU-BILT" means

"SUCCESSFUL OPERATION GUARANTEED"

That's all you need to know, folks!

D. C. MOTORS

	HP	Make	Type	Volts	Speed
3—	800/1000	Whse.		450	600/720
1—	800	G.E.	MPC	660	600
1—	700	G.E.	MCF	600	150/525
1—	650	G.E.	MPC	250	115/145
1—	600	G.E.	MPC	600	650/900
2—	350	G.E.	MPC	220	450
1—	335	Whse.	MQ	250	300/900
1—	325	Whse.		230	1050/1250
1—	300	G.E.	DMC	230	400/600
1—	300	G.E.	M-C	230	275/550
2—	300	Cr. Wh.	CCM-151-H	230	630/700
1—	250	G.E.	MPC	230	400/500
1—	250	Al. Ch.		230	525
1—	150	G.E.	MPC	230	250/450
1—	130	Cr. Wh.	CMC-65H	550	1200
2—	125	G.E.	CO	230	625
1—	100	G.E.	MPC	230	225/450
1—	75	Whse.	SK-180	125	650
1—	75	G.E.	C	230	500/1000
1—	75	G.E.	C	230	650/900
1—	60	El. Dy.	25-S	230	525/1050
2—	60	Whse.	Hoist	230	415
4—	50	Whse.	Hoist	230	400
2—	50	Cr. Wh.	65H	230	500/1000
5—	50-½ hr.	G.E.	MD-105B	230	550
1—	50	G.E.	RC-16	230	650
1—	50	Whse.	SK-160	230	565
1—	50	El. Dy.	50S	500	194/775
1—	50	Cr. Wh.	CMC-80H	230	380/750
1—	50	Cr. Wh.	CMC-81-H	230	300/900
1—	40	Whse.	SK-120	230	1700

TURBO GENERATOR SETS

1—500 KW Whse. 625 KVA. 440 V., 3 ph. 60 cy. 3600 RPM with Parsons' 145/175 lb. condensing turbine complete with jet condenser, and accessories.

1—300 KW GE. 375 Kva. 2300 V. 3 ph. 60 cy. 3600 RPM with Form D-53-300 KW Turbine, 160-lb. pressure, non-condensing.

1—300 K.W. Whse. D.C. 120/240 V., 1200 RPM. driven through reduction gear by steam turbine 5965 RPM., 440 lbs., 740° T.T. Condensing.

1—125 KVA. G.E., 2300 V., 3 ph., 60 cy., 3600 RPM. to 100 KW. Turbine 150/200 lbs., non condensing.

1—100 KVA. Whse., 2400 V., 3 ph., 60 cy., 3600 RPM. to Turbine 125/200 lbs., non condensing.

1—75 KW Ridgeway 250 V. D.C. with Terry 180 lb. pressure with 12 lbs. back pressure, 2000 RPM.

MOTOR GENERATORS SETS

3 ph. 60 cycle

1—1500 KW GE 275 V. d.c. to 2150 HP., 2200/4400 V. Syn. Motor with exciter.
2—1000 K.W. Whse. 450 V. D.C. to 1250 KVA. 2300 V., Syn. Motor.
1—500 KW. GE-600 V. d.c. to 700 HP-2300 V.
1—400 KW 3-unit with (2) 200 KW GE 125 V. D.C. gens. and 600 HP. 2300 V. Syn. Motor.
1—300 KW. G.E., 550 V. D.C. to 435 ATI, 2300 V. Syn. Motor.
1—300 KW 3 unit with (2) 150 KW Cr. Wh. 125 V. D.C. gens. and 360 KVA 4000 V. Syn. Motor.
1—200 KW-GE 250 V. d.c. to 300 HP-440 V.
1—150 KW Whse. 600 V. d.c. to 225 HP. 2300 V.
1—150 KW Whse. 3 unit (2) 75 KW 125 V. gens. d.c. to 200 HP. 2300 V. Ind.
2—120 KW Whse. SK-151 B 250/275 V. d.c. to 200 HP 2300 V. Ind. motor.
1—85 KW GE 250 V. DC to 150 HP 440 V. Sq. Cg. Motor.
1—75 KW GE 125 V. Gen. to 120 HP IK 4000/2300.
2—48 KW 3 unit with 2—24 KW GE 60 V. Gens. d.c. to 75 HP, 440 V. Ind. Motor.
1—50 KW GE 125 V. Gen. to 75 HP. KT 4000/2300 V.
1—26.4 KW W.E. 38 V. Gen. d.c. to 41.5 HP 320 V.
1—19.8 KW W.E. 33 V. Gen. d.c. to 32 HP. 220 V.

SPECIAL
1—500 KW G.E. 250 V. M-G Set, 700 HP. 2300/4000 V. 3 ph. 25 cycle, with controls.

ROTARY CONVERTERS

60 Cycle

	KW	Make	Speed	D.C. Volt	Trans. Volts
1—	1500	Whse.	720	600	2300
1—	1500	Whse.	600	600	11500
1—	1250	G.E.	720	250	2300
1—	1000	Whse.	900	600	11000
1—	750	Whse.	900	600	13200
1—	750	Whse.	720	250	6600/2300
1—	500	Whse.	1200	600	13200/2300

25 cycle

1—1500	G.E.	500	225/275	13200/6600

All units can be furnished with AC and DC Controls.

SPECIAL
1—2000 amp. 3 PST 15000 V. 250 V. Sal Operated Conduit type E-120-15D OCB 1,000,000 Kva interrupting Capacity.

A. C. MOTORS

3 ph. 60 cycle
Synchronous

	HP	Make	Type	Volts	Speed
2—	2100	G.E.	ATI	2300/4600	514
1—	660	G.E.	TS	2300	900

Slip Ring

1—	2500	G.E.	MT	6600	253
1—	800	Al. Ch.		440	835
1—	350	G.E.	MT442y	4000/2300	257
1—	250	G.E.	MT	4000	257
1—	225	G.E.	IM	550	720
1—	200	Whse.	CW	2200	580
1—	200	G.E.	I-M	440	514
1—	200	Whse.	CW-873C	440/2200	1160
1—	100	G.E.	I-M	550	430
1—	75	F.M.	BY	2200	1750
1—	60	Al. Ch.	ANY	220	700
1—	60	Cr. Wh.	123AQ	220	700
5—	50	Whse.	CI-504	220/440	870

Squirrel Cage

1—	725	G.E.	KT	13200/2300	590
1—	300	G.E.	IK-17B	2200	585
1—	250	G.E.	IK	440	600
1—	100	G.E.	IK-vert.	2300	450
3—	100	G.E.	K-6325Z	440	3600
1—	75	Al. Ch.		440	1,575

D.C. GENERATORS

	KW	Make	Type	Volts	Speed
1—	1200	Al. Ch.	MHC	525	750
1—	500	G.E.	MPC	600	720
1—	200	Al. Ch.		250	580
2—	200	G.E.	CY-214	250/275	900
1—	150	G.E.	MPC	125	200
1—	150	Whse..	SR-151B	275	1200
2—	100	Whse.		240	250

DYNAMOMETERS

1—100 HP Absorb. Block Test 250 V. 1050/4000 RPM GE type TLC-50.
15—35 HP-Absorb-Block Test-250 V. 825/2500 RPM GE-CD-105.

38TH YEAR OF SERVICE

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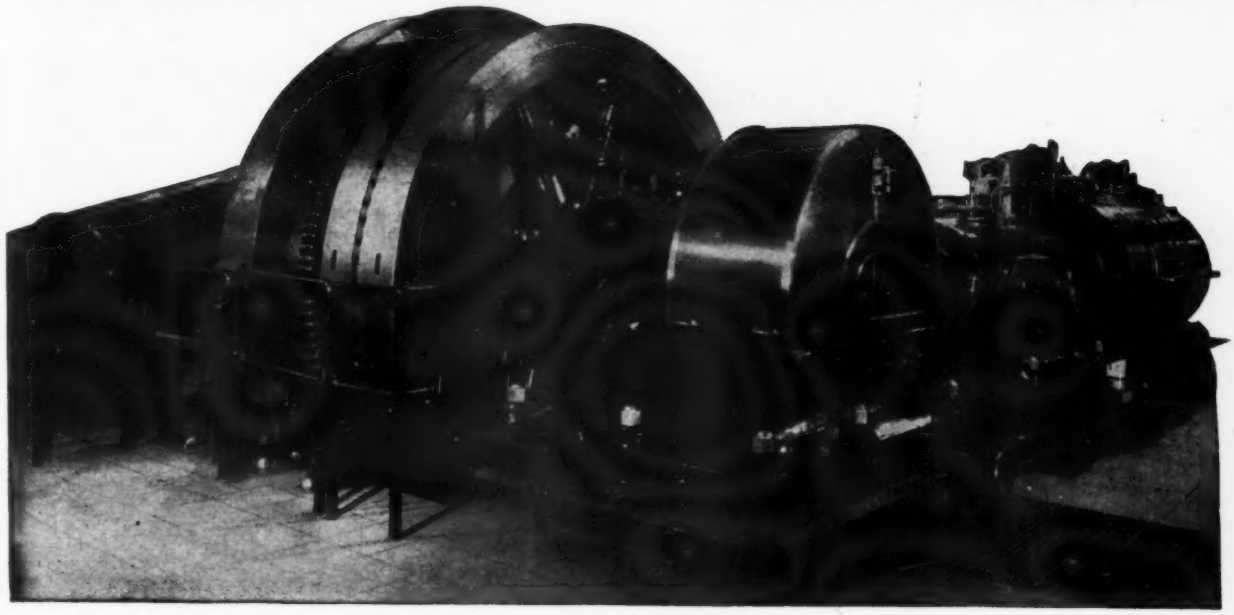
POWER PLANT MACHINERY



Actual Photograph

1000 KVA SKINNER UNIFLOW ENGINE GENERATOR UNIT

800 KW 80% P.F. 1000 KVA General Electric alternating current generator 3 phase 60 cycle 2300/600/480/240 volts 150 RPM direct connected to Skinner Universal Uniflow noncondensing engine, 125# steam pressure, 0-3# back pressure, complete with auxiliaries.

TURBINE UNITS
Condensing
3 phase 60 cycle

3750 KVA Wstgh.	4160 V. 200#
3500 KVA G.E.	2300 V. 200#
1875 KVA G.E.	2300 V. 175#
1563 KVA G.E.	600 V. 175#
1250 KVA Wstgh.	2300 V. 150#
940 KVA Wstgh.	6600 V. 250#
750 KVA G.E.	2300 V. 150#
625 KVA G.E.	2300 V. 175#

TURBINE UNITS
Automatic Extraction
3 phase 60 cycle

3650 KVA Wstgh. 2300 Volts, 150# pressure, 10# Extraction
1250 KVA G.E. 2300 Volts 150# pressure, 10# Extraction
1250 KVA Allis 480 Volts 300# pressure, 35# Extraction
780 KVA Wstgh. 2300 Volts 185# pressure, 15# Extraction
625 KVA Wstgh. 480 Volts 250# pressure, 25# Extraction

TURBINE UNITS
Noncondensing
3 phase 60 cycle

1563 KVA Kerr 2300 Volts, 200# pressure, 15# Exhaust
875 KVA Moore 2300 Volts, 300# pressure, 100# Exhaust
625 KVA G.E. 240 Volts, 200# pressure, 50# Exhaust
625 KVA G.E. 2300 Volts, 200# pressure, 10# Exhaust
250 KVA Wstgh. 480 Volts, 300# pressure, 30# Exhaust

DIESEL UNITS
3 phase 60 cycle

375 KVA Chic. Pn. 2300 V. 257 RPM
312 KVA (2) Fair. Mor. 2400 V. 300 RPM
300 KVA Fair. Mor. 240 V. 257 RPM
250 KVA Buckeye 240 V. 514 RPM
219 KVA Atlas Imp. 240 V. 514 RPM
118 KVA (2) Winton 240 V. 400 RPM

MOTOR GENERATORS
3 phase 60 cycle

300 KW (2) G.E. Syn. 275 volts D. C., 2300/4150 volts A. C.

UNIFLOW UNITS
3 phase 60 cycle

750 KVA (2) Skinner 2300 V. 175#
750 KVA Nordberg 4000 V. 175#
560 KVA Skinner 480 V. 150#
375 KVA 3-Unit Skinner Vertical 240 V. 150#
350 KVA Ames 2300 V. 150#
250 KVA (2) Ames Vertical 240 V. 160#
156 KVA Skinner 240 V. 150#

ROTARY CONVERTERS
3 phase 60 cycle

2000 KW Allis 600 volts D. C., 4150 volts A. C.
1500 KW Wstgh. 250 volts D.C., 2300 volts A.C.
1000 KW (2) G.E. 600 volts D.C., 33000 volts A.C.

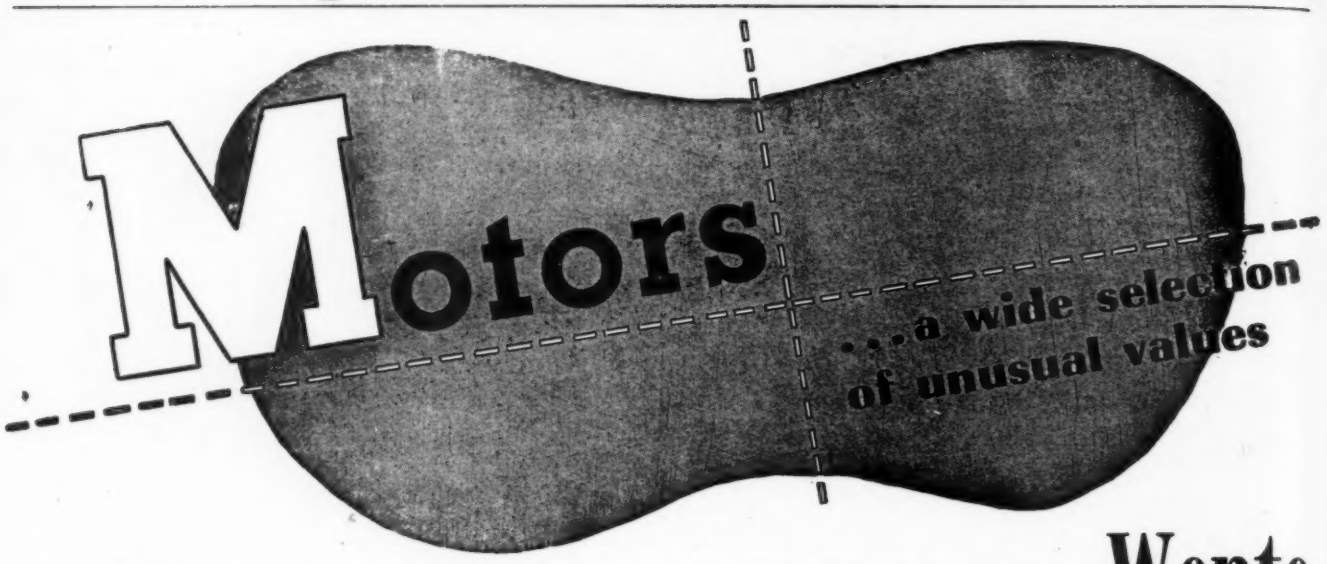
SPECIAL OFFERING

2—375 KVA Two unit (156 KVA and 219 KVA) Electric Machinery alternating current generators, 3 phase 60 cycle 240 volts 360 RPM direct connected to Skinner Vertical Universal Uniflow engines, two cylinders' 140-165# steam pressure 0-7# back pressure.

Used only two winters—Excellent condition

INTERNATIONAL POWER MACHINERY CO.

UNION COMMERCE BLDG. **Telephone: MAin 9514** **CLEVELAND 14, OHIO**



Listed below a few of the motors available in a hurry from Wente

SQUIRREL CAGE

3 Phase, 60 Cycle, 220/440 Volt.

Qu.	HP	Make	Type	Speed
5	200	G.E. 2300v.	FT527	1800
1	150	Al. Ch.		1750
2	125	L. A. 2300v.	Ball Bearing	3600
1	100	R'way 440v.		1200
1	100	West. 2200v.	CCL	1720
1	100	G.E.	I	340
1	100	G.E.	I	290
1	75	G.E.	KT562	450
1	50	G.E.	I	720
2	50	West.	MS 25 cy.	720
1	50	Wag.	BM	495
1	50	Al. Ch.		490
2	35	Al. Ch.	2 ph.	865
2	35	Al. Ch.		865
1	35	Ft. Wayne	2 ph.	900
1	35	G.E.	25 cy.	730
1	30	F.M. 2200v.	HD12B	3600
1	30	Al. Ch.		1200
1	20	Louis A.	KH	1170
1	30	West.	CCL	900
1	30	Wagner	22VBR	860
2	30	Al. Ch.	AN 2 ph.	860
1	30	Century	AS 25 cy.	720
1	25	Howell		1200
1	25	Lincoln		900
1	25	Al. Ch.		860
1	25	Rel. (elevator)	T.E.	750
1	25	Al. Ch.		720
1	25	G.E.	M10	720
1	20	Al. Ch.		1160
1	20	Al. Ch.		860
1	20	Al. Ch.		1700
1	20	Century		1740
1	20	F. M.	KRV	1200
1	20	West.		1200
1	20	Ideal	A	1150
1	20	Cleve.	M-147	900
1	20	Al. Ch.		860
1	20	West.	CS-644	870
1	20	West.	MS	900
1	20	West.	CCL	580
1	20	Wagner	CM	445
1	18	West.	MS-4 (Elev.)	720
1	15	West.	CCL	1700
1	15	Cr. Wh.	115Q	1720
2	15	West.	CS-573 25 cy.	725
2	15	West.	MS 25 cy.	725
1	15	West.	GS567C 25 cy.	715
1	15	West.	MS 25 cy.	600
1	10	West.	CS 25 cy.	725
1	10	West.	MS 25 cy.	720
2	10	West.	CS473C 25 cy.	615
1	7½	Wagner	MCP-365 TEFC	1140

SLIP RING

3 Phase, 60 Cycle, & Syn.

Qu.	HP	Make	Type	Speed
1	443	El. Mach.		900 Syn.
1	200	F.M.	BV	600
1	200	Westg. 2200v.		600 Syn.
2	75	F.M. 2200v.	BV-H16B	1800
1	50	Triumph	C12	1150
1	50	Ideal 2200v.	AV	575
1	50	G.E.	IM 25 cy.	700
1	50	Al. Ch.		690
2	40	G.E.	MT336	1200
1	40	Al. Ch.		1160
1	40	W'g 2200v.	CW	870
1	40	Westg.	CW-658-A	870
2	40	Al. Ch.		870
1	40	Westg.	C1753A 25 cy. cr.	730
10	35/15	G.E.	OMT336	1150/ 550
1	35	Al. Ch.	25 cy.	720
2	35	G.E.	IM	570
1	30	F.M.	AD Alt.	1200
1	22	G.E.	ITC5011 (hoist)	680
1	25	Westg.	MW 322A	680
1	25	G.E.	MT342	600
1	25	G.E.	MT356	400
1	20	Triumph	C10	1200
2	15	G.E.	MT302	1200
1	15	G.E.	MT332	720
1	15	G.E.	MT556	280
3	10	Westg.	CW464A	1200
1	10	Westg.	HF	1140
1	7½	G.E.	MT182	1750
8	2	G.E.	MT926 slip ring	1800

DC—230 Volt

Qu.	HP	Make	Type	Speed
1	75	Diehl	K11	700
1	100	G.E.	CD123	1200
1	60	Westg. 115v.	SK140L Vert.	1140
1	60	G.E.	EFI	1200
1	40	Rel. 440v.	13LT Vert.	1750
1	40	Rel. 440v.	230T Vert.	1130
1	25/40	C.W. 440v.	CMC-EH Vert.	1150/ 1750
2	40	Westg.	SK 123	1150
3	40	G.E.	RC32	1100
8	40	Westg.	SK 140	775
1	35	Al. Ch.		1200
1	35	G.E.	DLC 203	700
1	35	Westg.	SK 163 300/1200 Vert.	
1	30	El. Dy.	158	625
1	30	Rel. 440v.	131 T Vert.	1150
4	30	Reliance	92 TF	1750
1	27½	G.E.	CVC 116	1750
7	25	Westg.	SK 120	825
2	25	Westg.	SK 103	1150
1	25	Westg.	SK 90	1400
4	25	Westg.	SK 100 L	1150
1	20	G.E.	RC 51B	1150
1	25	Westg.	SK 123 550/1100	
1	25	Al. Ch.	E 120 500/1500	
1	25	J. & L.		625
2	20	Reliance	131T	1000
2	20	Diehl	K914A 500/1500	
1	20	G.E.	RF12 250/1000	
1	20	Lincoln	FKW B.B.	1800
6	20	Cr. Wh.	CMC T.E.B.B.	1750
1	20	Cr. Wh.	CMC T.E.B.B.	1150
1	20	Westg.	SK93	1150
14	20	Reliance	92T	1150
1	20	Westg.	SK 120 T.E.	1100
3	20	Westg.	SK 100L	900
1	20	Watson	K	850
3	20	Reliance	131T	850
1	20	G.E.	RC30	750
1	20	Westg.	SK110L-115V	750

DC—230 Volt

Qu.	HP	Make	Type	Speed
4	20	Westg.	SK110L	750
1	20	Cr. Wh.	CW-CMC	600
1	20	Westg.	SK120	500
3	20	Al. Ch.	K	500/100
2	15	Westg.	SK63	1750
1	15	Westg.	SK113 encl.	1750
1	15	Westg.	SK93	1150
4	15	Westg.	SK83	1150
4	15	Cr. Wh.	CW-CCM T.E.	1150
1	15	Westg.	SK70L	1250
1	15	G.E.	CD83	1150
1	15	G.E.	RC10	1150
1	15	G.E.	RC29	1150
4	15	Westg.	SK93	850
4	15	Reliance	92TF	850
4	15	R. & M.		1000
1	15	G.E.	CVC-115	925
6	15	Westg.	SK90 Vert.	825
1	15	G.E.	RC29	750
6	15	Westg.	SK110L	675
1	15	Al. Ch.		1075
8	15	Reliance	131T	550
3	15	Reliance	92T	850/1750
3	15	Reliance	92T	850/1700
1	15	Reliance	66T	800/1600
1	15	Westg.	SK	500/1500
2	15	Westg.	SK110L	400/1600
1	15	Triumph	32F	900/600
1	15	Triumph		225/900
1	12½	Westg.	SK	750/1500
7	10	Westg.	SK70	850
2	10	G.E.	RC29	850
2	10	Reliance	66TF	850
20	10	Westg. SK60L-SK60-Reliance 46TF		1150
7	10	Cr. Wh.	CM CHB T.E.B.B.	1750
1	10	G.E.	RF11	600/2400
3	10	G.E.	RF10	600/1800
6	10	Westg.	SK80L	500/1500

DC—230 Volt

Qu.	H.P.	Make	Type	R.P.M.
23	10	Al. Ch.		800/1000
1	10	G.E.	RF10	400/1200
2	10	Kimble	BA324 new B.B.	1750
1	10	Westg.	SK91	250/1000
15	7½	Westg.	SK33	1750
16	7½	Westg.	SK43	1140
20	7½	Westg.	SK60	850
20	5	Westg. & G.E.		1750
20	5	Westg. Rel.		1150
35	5	Westg.	SK43	580
50	3½	Westg.	SK33	850
50	3	Westg.	CD925	1725
70	3	Westg.	SK20	1550
60	2	Westg.	SK & CD	1150
50	2	Westg.	SK20	850
40	1½	Westg.	CD	1150
30	1½	Westg.	CD925	550/2200

50 New vertical, 3 phase, 220/440 volt, 60 cycle, as follows:
1—Fairbanks Morse, 3 HP, 1200 RPM, Type QZCU, Frame 254
2—Howell, 3 HP, 1200 RPM, Type KV Frame 254
2—Delco 3 HP, 1200 RPM, Type C Frame 254
2—General Electric, 5 HP, 1200 RPM, Type K Frame 254
1—General Electric, 5 HP, 1800 RPM, Type K Frame 254
6—General Electric, 7½ HP, 1200 RPM, Type K Frame 284
8—Delco, 7½ HP, 1200 RPM, Type C Frame 324
1—Howell, 7½ HP, 1200 RPM, Type K Frame 324
5—Howell, 7½ HP, 1800 RPM, Type KV Frame 284
4—Howell, 10 HP, 1200 RPM, Type K Frame 326
6—Delco 10 HP, 1200 RPM, Type C Frame 326
6—Delco 15 HP, 1200 RPM, Type CL Frame 365
2—Howell, 15 HP, 1200 RPM, Type KV, Frame 365
2—Delco, 20 HP, 1200 RPM, Type CL, Frame 404
2—Howell, 20 HP, 1200 RPM, Type K Frame 404

1—New 40/50 HP Westinghouse, type SK, frame 141, 230 Volt, DC, 300/1200 RPM, ball bearing
6—New General Electric Synchronous Motors Type T.S. 200 H.P. 300 RPM, 2200 volt .8 p.f. Complete with control & separate motor generator exciter set.
1—150 KW Westinghouse, synchronous M-G set, 275 Volt DC, 2200 Volt AC, 3 phase, 60 cycle, 900 RPM, with AC control and DC panel
1—150 KW Westinghouse, synchronous M-G set, 275 Volt DC, 4400 Volt AC, 3 phase, 60 cycle, 900 RPM, with AC control and DC panel
4—New 40 KW, ball bearing, Imperial M-G sets, 250 Volt DC, 220/440 Volt AC, 3 phase, 60 Cycle, 1750 RPM
12—1250 K.V.A. 3/60/2300 B. 720 RPM 2 bearing Westinghouse Synchronous Motors or Generators with Direct Connected Exciters. Built 1942. With or Without Hydraulic Couplings

The Wente Electric Co.

Hamilton, Ohio

Rebuilt Motors & Generators
Since 1906

NOW LET'S GO!—D.C. MOTORS GENERATORS

1 YEAR GUARANTEE

125 V. - 250 V. - 550 V. D.C. GENERATORS (Motor Driven and Belted)

KW	Make	Voltage	Ampere	Speed
300	West.	250	1200	900
300	Al. Ch.	250/125	1200	1200
250	G.E.	125	2000	690
200	Cr. Wh.	550	363	900
150	G.E.	250	600	580
100	G.E.	125	800	1150
100	Al. Ch.	250/125	400	1150
100	Cr. Wh. (3)	125	800	1150
75	Cr. Wh.	125	600	1200
75	Cr. Wh.	125	600	1150
75	West. (4)	250	300	1200
60	West. (2)	125	480	1800
60	G.E.	125	480	900
50	G.E. (2)	125	400	1150
40	Century	125	320	1450
40	West.	250/125	160	1500
40	G.E. (2)	250	160	800
25	Allen	110	320	500
30	G.E. (3)	250	120	1750
20	Delco	125	160	1200
20	West. (6)	125	120	1200
20	G.E. (2)	125	160	400
15	West.	125	120	1750
15	Roth	125	120	900
15	Hobart	250	60	1750
15	West.	230	60	1450
15	G.E.	125	120	1150
15	Scott	110	136	500
15	G.E. (3)	125	120	850
12½	F.M.	125	100	1450
10	Rogers (2)	125	80	1450
10	El. Dy.	125	80	600
8	G.E. (2)	125	64	1800
7½	G.E.	125	60	1800
5	G.E. (2)	125	40	1740
5	Rel.	250	20	1725

80—Additional generators—125 V. up to 2000 V. generators in stock.

LOW VOLTAGE D.C. GENERATORS

KW	Make	Voltage	Ampere	Speed
1-6/1;	Hertner	80	20	1800
75	G.E.	75	1000	1145
22½	West.	75	300	720
24	G.E.	60	400	1800
1-1/8	G.E.	60	19	1800
3	Hertner	60	60	1730
40	G.E. (6)	50	800	1160
3/4	H.C.	46	11½	1750
8½	G.E. (3)	42	205	1800
5	Diehl	40	125	1750
33	G.E.	33	1000	850
6½	G.E. (2)	32	205	1800
2½	Witte	32	75	1800
3	G.E.	30	100	1200
48	West.	30	1600	600
6	Star (2)	25	250	1800
5	Star	25	200	1750
15	Rel.	24	625	1450
4	Star	20	200	1800
1	G.E.	20	15	1800
1	West.	16	60	1750
22½	Star	15	1500	1200
15	G.E.	15	1000	1200
11	Star	15	750	1200
1	Cont. (2)	15	67	1750
4½	Star	15	300	1800
30	Columbia	8-16	5000/2500	720
12	K.V.W.	6/12	2000/1000	900
7½	Eddy	5/10	1500/750	860

300—Additional low voltage generators in stock.

D.C. MOTOR DRIVEN A.C. GENERATORS

31 KVA Ideal 3 phase output driven by 40 H.P. 115 V. D.C. motor.

25 KW Electric Machinery 3 phase output driven by 40 H.P. 230 V. D.C. motor.

7½ KVA Star single phase output driven by 125 volt D.C. motor.

5 KVA Electric Specialty single phase output driven by 115 V. D.C. motor.

2½ KW Diehl single phase output driven by 110 volt D.C. motor.

1 KW Allis-Chalmers single phase output driven by 110 V. D.C. motor.

150—Additional units in stock including small size rotary convertors.

230 V. D.C. MOTORS

Qu.	H.P.	Make	Type	Speed
1	350	West.	SK	340/425
1	100	West.	SK-180	625
1	100	Rel.		475/635
1	75	West.	SK	475
1	60	West.	SK-153	850/1200
3	60	West.	SK-160	680
1	60	G.E.	C	480/1100
1	50	West.	CK-9	525
1	50	G.E.	RC-19	400/1200
1	45	Diehl	K-10	850
2	40	G.E.	DLC-25	1050
1	40	Cr. Wh.	CCM	700
1	35	G.E.	RLC-204	440/800
2	35	West.	SK-160	400
1	30	G.E.	RC-32	1100
1	30	West.	S-6	1025
1	30	West.	SA	975
2	30	West.	SA	500/1500
1	25	El. Dyn.	10-S	1500
2	25	G.E.	RC-31	1150
1	25	West.	SK	1100
1	25	Rel.	92T	1150
1	25	West.	SK	900
1	25	G.E.	LC	900
1	25	Al. Ch.		850
4	25	G.E.	RF-12	500/1500
1	25	West.	SK	500/1500
1	25	G.E.	RF-11	500/1000
4	25	G.E.	RF-14	300/1200
1	25	G.E.	RF-14	300/900
1	25	West.	SA	325/975
2	20	West.	S	1300
1	20	R. & M.		1160
1	20	G.E.	CD-85	1150
1	20	G.E.	RC-11	1150
1	20	West.	SK-103	1200
1	20	West.	S-6	975
2	20	West.	SK-63	850
1	20	G.E.	RC	800
1	20	Al. Ch.	series	625
1	20	West.	HY-6	700
1	20	G.E.	RF-11	500/1500
10	20	G.E.	RF-12	400/1200
2	20	Star	SHB-30	29.2
2	16/25	Cr. Wh.	35-JA	400/1200
1	15	Roch.		3450
1	15	West.	SK-63	1750
4	15	Star	SQ-1520	1290
1	15	G.E.	RC	1200
1	15	West.	SK-80L	1100
1	15	G.E.	RC-29	1150
1	15	G.E.	RC-10	1150
1	15	G.E.	CDV-85	900
1	15	West.	SK	850
1	15	G.E.	CDE-83	850
2	15	G.E.	RC-30	850
2	15	G.E.	D	700
1	15	West.	SK	675/1350
1	15	G.E.	CQ	625
1	15	El. Dy.	5S	600/1200
1	15	G.E.	CQ	600/1500
1	15	West.	SK-100	600/2500
1	15	G.E.	LC	675/1150
1	15	Al. Ch.		400/1600
2	15	Rel.	155T	400/1600
1	15	G.E.	CD	400/1600
1	15	West.		400/1600
2	15	West.	SK-100L	500/1500
1	15	G.E.	RF-10	550/1000
1	15	G.E.	RF-11	400/1600
1	15	West.	SK	250/1100
1	15	Diehl		200/247
1	10	R. & M.		1300
1	10	West.	S	1325
1	10	G.E.	CD-75	1150
1	13	National	series	1100
1	10	G.E.	RC	1100
1	10	Triumph	TR-10S	860
1	10	G.E.	RC-29	850
1	10	Dieh.	LS-14	750
1	10	West.	SK-7L	700
2	10	G.E.	CVC	700
1	10	Cr. Wh.	CSM	675
1	10	West.	SK	600/1200
2	10	G.E.	RLC	500/1500
1	10	G.E.	RF-10	400/1600
1	10	West.	SA	400/1200
1	10	G.E.	RF-10	400/1200
1	10	Rel.	131T	250/1000
1	7½	Sturt.		3600
1	7½	L.A.	284	1750
1	7½	El. Dy.	2S	1750
2	7½	Rel.	235	1750
1	7½	West.	SK-30	1750
1	7½	G.E.	RC	1700
1	7½	West.	SK	1800
2	7½	Cr. Wh.	CCM	1425
3	7½	West.	SK	1100
1	7½	G.E.	RC	1100
1	7½	G.E.	CO-1804	1200/3200
1	7½	West.	SA	975
2	7½	West.	SK-50	975
1	7½	Cr. Wh.	SM	910
1	7½	G.E.	RC	900
1	7½	Cr. Wh.	CCM	875
2	7½	G.E.	RC	850
1	7½	West.	SK-60	850
1	8½	West.	SK-30	825
1	7½	G.E.	RF-10A	600/1500
1	7½	West.	SK-90	650/1300
1	7½	El. Dy.	3S	550/1650
2	7½	L. A.	BW-15	525/1150
1	7½	Roth	RS-107	450/900
1	7½	West.	SK-70	400/1600
1	7½	West.	SA	400/1600
1	7½	G.E.	RLC	400/1600
1	7½	Al. Ch.		350/1050
1	5	Star	SB-5	1750
1	5	Rel.	T-254	1750
2	5	West.	SK-20	1800
2	5	G.E.	RC	1700
1	5	G.E.	CDV	1750
1	5	West.	SK-23	1750
1	5	G.E.	CVC	1650
4	5	G.E.	CVC	1100
1	5	G.E.	CD-65	1150
1	5	Rel.	32T	1150
8	5	G.E.	RC-27A	1150
2	5	West.	SK-43	1150
1	5	G.E.	B-284	1150
3	5	Cr. Wh.	CCM	950
1	5	West.	SK-23	920
1	5	West.	SC-3	870/1750
1	5	Rel.	23T	850/1700
1	5	Al. Ch.	E-75	850
1	5	G.E.	RC	600
1	5	Cont.	D-49	600/1800
1	5	Star	SB-10	600/1200
1	5	El. Dyn.	3-S	550/1650
2	5	West.	SK-60	500/1500
1	5	Cr. Wh.	CM	400
2	3	G.E.	BD-235	3600

800—Smaller D.C. motors in stock including fractional.

110 V. D.C. MOTORS

Qu.	H.P.	Make	Type	Speed
1	60	Star	SQ-60L	1200
1	45	G.E.	RC	1100
1	25	Star	15-L	2400
1	25	G.E.	CDM-85	1200
1	20	G.E.	CD-83	1750
1	16	Cr. Wh.	CMC-L	1750
1	15	West.		1150
1	15	El. Dy.	7½ S	615/1230
1	15	West.	S	560
4	10	Lincoln		3500
1	10	L. A.		3500
1	10	Al. Ch.	EBC-75	2175
1	10	G.E.	CD-73	1750
1	10	West.	SK-70L	850
1	10	Cont.		825
1	10	Rel.		400/1600
1	10	Diehl.		230
1	7½	G.E.	RC	1700
1	7½	I.G.B.		1300
1	7½	Cr. Wh.		1700
1	7½	Al. Ch.		1350
1	7½	West.	S	975
1	7½	G.E.	CVC	825
1	7½	El. Dy.	5 S	450/900
2	7½	Broomfield		1725
1	7½	West.	SK-394	84
1	7½	El. Dyn.	5S	600/1200
1	5	Kimble	BA-225	3500
1	5	Marathon		3500
1	5	West.	SK	1750
1	5	Diehl	DPL-8	1750
1	5	West.	SK	1200
1	5	G.E.	CVC	1150
1	5	Burke	AB-5	1200
1	5/10	El. Dy.		900/1800
1	6	Burke	WAB-14	650
1	5	Cr. Wh.	CMC	900/1800
1	5	Imperial	D-35	500 750
1	5	Rel.		450/1800
1	5	West.	SK-70L	500
1	5	Watson	MW-15	350
1	5	El. Dy.	7½ S	260
1	5	Diehl		247
1	3	G.E.	RC	2100
1	3	F.M.	LA225	1300
1	3	Cont.	D-31	1150
1	3-3/4	Cr. Wh.		600
1	3	G.E.	CD-73	900/1800
1	3	Cr. Wh.	CMC	535/1050
1	3½	West.	SK	450/1800
1	3	El. Dy.	3S	450

800—Smaller size 110 V. D.C. motors including fractional horsepower motors also in stock.

SEND US YOUR INQUIRIES FOR A.C. EQUIPMENT

L. J. LAND, INC.

Established 1910

146 GRAND STREET, NEW YORK 13, NEW YORK

CAnal 6-6976

New England Representative
BOSTON, MASS., 411 Atlantic Ave.
Phone: Liberty 4300

Pennsylvania Office
READING, PA., 10th & Exeter Sts.,
Phone: Reading 2-6866

THE GLOW ELECTRIC CO.

SPECIAL—NEW PLATING GENERATORS

200 Amp., 10 to 15 volt, 1725 RPM, direct current, Master Plating Generators with overhung exciter.

MOTOR DRIVEN CENTRIFUGAL PUMP

Dayton Dowd, size 6x18 CSLF, rated 7250 G.P.M. 30 ft. head, at 685 RPM Centrifugal Pump mounted on common base and driven by: — Continental 75 HP, 695 RPM, 2200 volt, 3 phase, 60 cycle, drip proof motor.

COPPER OXIDE PLATING RECTIFIERS

600 Amp., 6 volts, Direct Current, for 440 volt, 3 phases, 60 cycle power, General Electric, Model 6RC120F2.

GAS ENGINE—A. C. GENERATOR SETS

7½ KVA, 110 volt, 3 phase, 60 cycle with 4 cylinder Wisconsin Engines, U. S. Army PE99F, complete with switchboard panel.

10 KW, 1800 RPM, 125/250 volt, 1 phase, 60 cycle, A. C. Generator with 4 cylinder gas engine. Complete with switchboard panel.

SIX NEW DIRECT CURRENT MOTORS

25 HP, 1750 RPM, 230 volt, compound wound, Marble-Card motors, Marine type, drip proof.

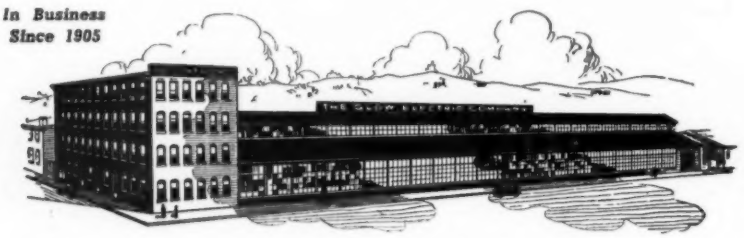
NEW A. C. GENERATORS

5 KVA, 1800 RPM, 120/240 volt, 1 phase, 60 cycle, Master Generators with overhung exciters—generators single bearing for direct connection to driving motor or engine. Complete with switchboard.

SPEED REDUCERS

H.P. Input	Ratio	Input RPM	Manufacturer
1/8	1500 to 1	1800	Winfield H. Smith
1/2	660 to 1	1800	Winfield H. Smith
1	2235 to 1	1800	Winfield H. Smith
1	578 to 1	1800	Foote
3.46	5 to 1	1800	Foote
4	286 to 1	1800	Winfield H. Smith
4.22	6¼ to 1	600	Foote
5	6 to 1	720	D. O. James
5	40 to 1	400	Gears & Forgings
5.72	5	1750	Foote
7½	8.83 to 1	5000#ft.	King Mach
7½	54 to 1	1150	Jones
10	15.16 to 1		Patt. Foundry & Mach.
30	36 to 1	1200	Jones
35/75	10.4 to 1	1170	R. D. Nuttall
	5.3 to 1	1170	
19.5/80.5			
	4⅜ to 1	100/1750	Foote Bros.
100	4¾ to 1	900	Poole Engr.
300	4.04 to 1	3640	Kerr
375	3.6 to 1	3600	General Electric

In Business Since 1905



SPECIAL

POWER SAW — Red Star, MULTIPLEX for 20" Saw, Universal head with 5 HP, ball bearing, 230 volt direct current motor. Complete with table and control.

Late Type TURBO-GENERATOR SET

Westinghouse, 300 KW, 1200 RPM, 120/240 volt, compound wound, D.C. Generator with interpoles, directly connected to:

Joshua Hendy Steam Turbine, 5965 RPM, for steam conditions of 440 lbs. per sq. inch gauge inlet pressure, 28½" vacuum, 740 deg. F. total temperature. Including speed reducer, rheostat and balancer coil.

WELDER SETS

Amps.	Voltage	Manufacturers	Driven By
75	25	Hobart	3 HP, 220/440 V., 3 ph. 60 cy.
100	25	Lincoln	5 HP, 220 volt, 3 ph. 60 cy.
125	25	Ideal	7½ HP, 220 volt, 3 ph. 60 cy.
150	70	Arc Weld Mach. Co.	No Motor
150	45/35	Wilson Plastic Arc	7½ HP, 230 volt, Direct Current
150	25	Imperial	No Motor
150	6 arc capacity	Arc Weld Mach. Co.	30 HP, 220 volt, 3 ph. 60 cy.
175	55/25	Westinghouse	7½ HP, 220/440 V., 3 ph. 60 cy.
200	60/20	General Electric	1800 RPM—No Motor
200	60	Todd	7½ HP, 220 volt, 3 ph. 60 cy.
200	40	Lincoln	10 HP, 220 volt, 3 ph. 60 cy.
200	25	Lincoln	10 HP, 220 volt, 3 ph. 60 cy.
300	25	Westinghouse	15 HP, 230 volt, Direct Current Motor
300	25	Westinghouse	15 HP, 230 volt, Direct Current Motor
300	40	Wilson, single bearing for direct connection at 1800 RPM	
300	40	Lincoln	20 HP, 440 volt, 3 ph. 60 cy.
300	40	Lincoln, single bearing for direct connection at 1400 RPM	
300	40	Ideal	20 HP, 220 volt 3 ph. 60 cy.
400	20	Wilson	No Motor
500	60	Westinghouse	45 HP, 220 volt, 3 ph. 60 cy.
1000	30	Westinghouse	50 HP, 220 volt, 3 ph. 60 cy.
1000	60	Westinghouse	92 HP, 220/440 V., 3 ph. 60 cy.
400	40	Lincoln	25 HP, 220 volt, 3 ph. 60 cy.

AC & DC MOTORS • GENERATORS • PUMPS
SYNCHRONOUS MOTORS • CONTROL EQUIPMENT
MOTOR GENERATOR SETS • ELECTRIC HOISTS
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

933-943 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

FOR SALE—IMMEDIATE DELIVERY

POWER PLANT EQUIPMENT

TURBINE-GENERATOR UNITS

3 Phase, 60 Cycle

2500 KVA Allis automatic extraction condensing, 200 to 300 lbs. pressure, 2300/600 volts, 3600 RPM equipped with direct connected exciter, condenser and switchboard.

2500 KVA G.E. condensing, 150 to 200 lbs. pressure, 2300 or 550 volts, 1800 RPM complete surface condenser, exciter and panel.

2500 KVA Westinghouse condensing, 180 lbs. pressure, 2300 volts, 3600 RPM, complete surface condenser, exciter, switchboard.

1875 KVA Westinghouse condensing, 175 to 200 lbs. pressure, 500° TT, 480 volts, 3600 RPM, complete with turbine driven exciter set, switchboard.

1563 KVA (2) G.E. automatic extraction condensing, 150 to 200 lbs. pressure, 480 volts, 3600 RPM equipped with direct connected shaft exciters, condensers, and switchboards.

1250 KVA Westinghouse Non-condensing, 200 to 250 lbs. pressure, 500° TT, 15 lbs. gauge back pressure, 480 volts, 3600 RPM, complete with exciter, switchboard panel.

1250 KVA Westinghouse condensing, 2400 volts, 3600 RPM, 200 lbs. pressure, equipped with direct connected shaft exciter, condenser, and switchboard.

940 KVA Westinghouse condensing, 150 lbs. pressure, 2400 volts, 3600 RPM equipped with exciter, surface condenser, switchboard.

938 KVA Allis Automatic Extraction condensing, 250 to 300 lbs. pressure, 500° TT, 2300 volts, 3600 RPM, complete surface condenser, exciter and switchboard.

375 KVA G.E. condensing, 150 to 200 lbs. pressure, 100° SH, 2300 volts, 3600 RPM, complete with surface condenser.

250 KVA G.E. non-condensing, 240 lbs. pressure, 5 lbs. gauge back, 220 volts, complete exciter and panel.

125 KVA Westinghouse non-condensing, 175 to 200 lbs. pressure, 0-10 lbs. gauge back, 240 volts with direct connected exciter and switchboard.

125 KVA G.E. non-condensing, 175 to 200 lbs. pressure, 10 lbs. gauge back, 2300 volts, 3600 RPM complete.

100 KVA Westinghouse non-condensing, 125 to 150 lbs. pressure, 10 lbs. gauge back, 2400/600 volts, 3600 RPM.

ENGINE-GENERATOR UNITS

3 Phase, 60 Cycle

Alternating Current

575 KVA General Electric, 460 volts, 150 RPM generator direct connected to 24″ x 36″ Nordberg Unaflow engine, 150 to 175 lbs. pressure, 10 to 40# back pressure.

500 KVA Westinghouse, 460 volts, 164 RPM generator direct connected to 26″ x 28″ Skinner Unaflow non-condensing engine, 140 to 160 lbs. pressure, 0 to 10 lbs. gauge back pressure. Complete installation.

500 KVA G.E. 2300 volt generator direct connected to Chuse Unaflow engine.

312 KVA Elliott, 4000/2300/550 or 240 volts, 180 RPM generator, direct connected to a 17″ x 24″ Elliott Unaflow non-condensing engine, 175 lbs. pressure, 6 lbs. back pressure.

312 KVA G.E. 480 volts, 200 RPM generator direct connected to Skinner Unaflow non-condensing engine—Complete.

25 KVA E. M. 2300 volts, 200 RPM generator direct connected 19″ x 24″ Chuse Unaflow poppet valve engine.

200 KVA Crocker-Wheeler, 240 volts, 400 RPM generator direct connected to Ames vertical Unaflow engine, 110 to 125 lbs. pressure, 5 lbs. gauge back.

150 KVA G.E. 240 volts, 225 RPM generator direct connected to Ames Unaflow engine.

75 KVA Allis 2300/550 or 440 volt, 257 RPM generator direct connected to 12″ x 16″ Chuse 4 valve non-releasing Corliss engine.

ENGINE-GENERATOR UNITS

Direct Current

300 KW Allis-Chalmers, 250 volts, 150 RPM generator direct connected to 24″ x 28″ Chuse Unaflow non-condensing engine, 130 to 150 lbs.

125 KW, 125 volts, 250 RPM generator direct connected to 18″ x 16″ Elliott engine, 100 lbs. pressure, 10 lbs. back pressure, complete with switchboard.

75 KW Westinghouse, 125 volt, 1800 RPM non-condensing turbine generator.

75 KW Allis-Chalmers Terry, 125 volts, 2400 RPM non-condensing turbine-generator unit.

15 KW (2) Crocker-Wheeler, 125 volts, 410 RPM generators each direct connected to an American Blower vertical engine.

SPECIAL OFFERINGS

125 KVA (4), 3 phase, 60 cycle, 480 volts, 514 RPM Electric Machinery horizontal synchronous generators. NEW.

300 HP 6 cylinder, style VA, 257 RPM Fairbanks Morse vertical full Diesel engine direct connected to a 200 KW 80% PF—240 KVA, 3 phase, 60 cycle, 2300 volts, 257 RPM Fairbanks Morse alternating current generator.

500 KVA Westinghouse, 3 phase, 60 cycle, 600 volts, 514 RPM belted generator.

750 KVA Westinghouse, 3 phase, 60 cycle, 2300 volts alternating current generator, direct connected to 910 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

1000 KW, 265 volt direct current—6 phase, 60 cycle, 514 RPM Westinghouse booster type rotary converter complete with transformers.

1200 KVA General Electric, 3 phase, 60 cycle, 2400 volts alternating current generator direct connected to 1700 HP, 3 phase, 25 cycle, 2300 volts, 300 RPM synchronous motor.

3480 sq. ft. Allis surface condenser.

6000 sq. ft. C. H. Wheeler surface condenser.

10 Ton Brown Hoist hand-operated crane with 31′ 0″ span, approximately 150 ft. 15″ I-beam with 6″ wide flange.

2—10 Ton Yale Spur Geared Chain Block Hoists.

20 Ton Capacity Overhead Armington Engineering Company traveling crane.

6200 GPM at 40′ head, 850 RPM Dayton Dowd centrifugal pump less motor.

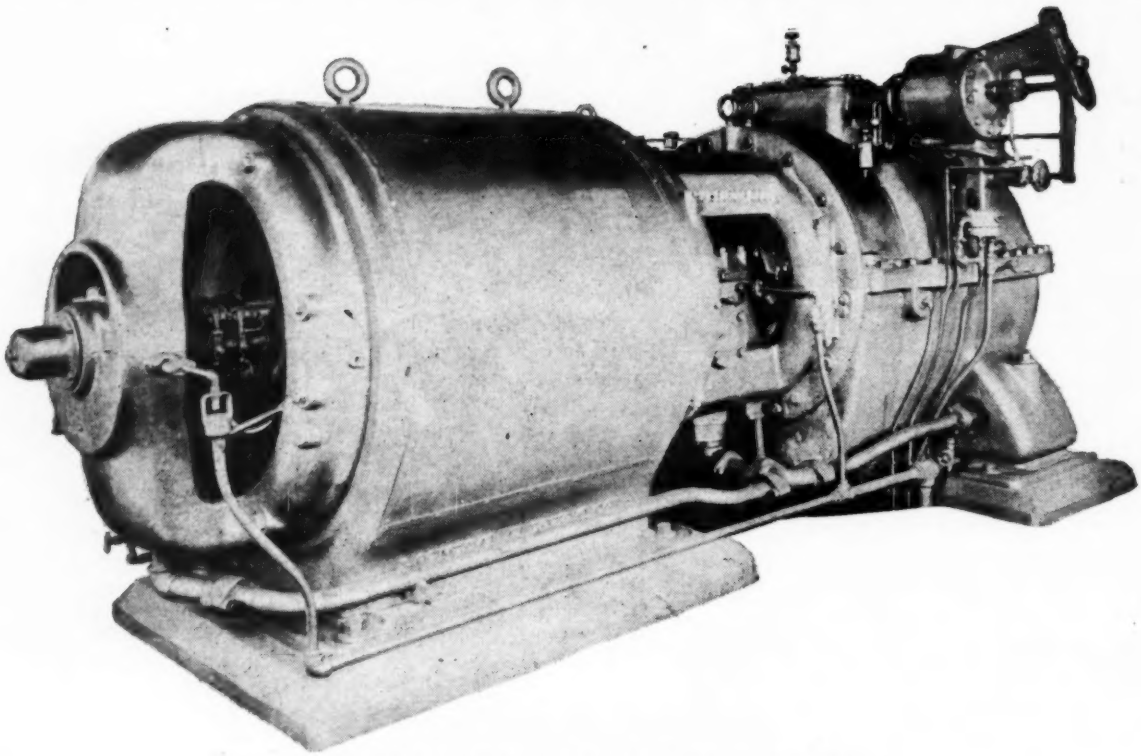
1—ALLIS-CHALMERS SYNCHRONOUS MOTOR GENERATOR SET CONSISTING OF: 1500 KW 550/600 volts, 300 RPM compound wound interpole direct current generator direct connected to a 2190 HP, 3 phase, 60 cycle, 4000 volt, 300 RPM, A.C. motor.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG.
CLEVELAND 14, OHIO

WIRE OR PHONE
LONG DISTANCE 422

TURBO-GENERATORS



A Partial List of Our Stock Is Noted Below

28000—KVA-West. Surf.Cond. 250/400# 2300-V

2—1565 KVA. G.E. Aut. Ext. 30# 200# ISP. 3/60/480-V

6250—KVA-G.E. Surf.Cond. 200# 2300-V

6250—KVA-A-C. Non.Cond. 425# 185#-BP

3750—KVA-G.E. Surf.Cond. 200# 2300-V

2500—KVA-G.E. Surf.Cond. 200# 2300-V

2500—KVA. G. E., Non-Cond. 30#-BP. 200 PSI., 480-2300-V

2500—KVA West. 200#-PSI. 2300-V, Sur. Cond.

2500—KVA. Allis-C., Cond. Aut. Ext. 30#. 200# PSI., 2300-V

937—KVA. Murray-Allis Aut.-Ext. 30#: 300# PSI., 2300-V

1875—KVA-G.E. Cond'sing. 200# 2300-V

1565—KVA-G.E. Surf.Cond. 150# 2300-V

1250—KVA-A-C Non-Cond. 150# 480-V

1250—KVA-West. Surf.Cond. 200# 2300-V

937—KVA-A-C Condens'g 480-V

Also Specialists in Diesel Engines, Boilers & Genl. Power Plant Eqpt.

WE OWN and CAN SHIP FROM STOCK

450-HP Baldwin Diesel Engines **320-HP Atlas Imperial Diesel Engines**

Also Any Other Size or Capacity Diesel Engine Desired

WRITE OR WIRE US

CHARLES WEAVER & COMPANY

4045 Penobscot Building—Telephone Cadillac 1340-1

DETROIT, MICH.

THESE ARE ALL SOUND UNITS

WE CAN RECOMMEND INSPECTION

TURBO ALTERNATORS

CONDENSING

300 KW 240 V 150# 100° Surf Cond (new 1929) factory rebuilt
500 KW 2400 V 150# 100° Surf Cond (new 1919)
500/750 KW several other good units available
1000 KW (3 units) 2400 V 150# 100° Jet Cond (new about 1922)
1000 KW 2400 V 200# 100° Surf Cond (new 1925)
1250 KW 2400 V 200# 100° Surf Cond (new 1924)
1500 KW 480 V 200# 100° Jet Cond (new 1920)
2000 KW 600 V 200# 100° Jet Cond (new 1920)
2500 KW 2400 V 200# 100° Jet Cond (new 1922)
3000 KW 600 V 200# 100° Surf Cond (new 1931)
5000 KW 2400 V 175# 100° Jet Cond (new 1920)
7500 KW 2400 V 175# 100° Surf Cond (new 1919)
12500 KW 6900 V 200# 100° Surf Cond (new 1924)

EXTRACTION—CONDENSING

1000 KW 2400 V 175# 100° ISP Automatic Control 5 to 15# g. Extr.
1250 KW 480 V 175# 100° ISP Automatic Control 5 to 15# g. Extr.

EXTRACTION NON-CONDENSING

750 KW 480 V 175# 100° ISP; 75# g. Extr. Automatic Control; 10# g. BP

NON-CONDENSING

100 KW 240 V 175# 100° ISP 0 to 5# g. BP (new 1921)
200 KW 600 V 200# ISP 0# BP (new 1924)
500 KW 480 V 175# 100° ISP 5 to 20# g. BP (new 1920)
2000 KW 2400 V 175# 100° ISP 5 to 15# g. BP Rebuilt

PLANT COMPLETE

3000 KW 480 V 400# 650° ISP; approx. 110,000# process steam at 50# g.

DC TURBO UNITS

750 KW 250 V 16#/165# (M.P.) Jet Condenser
150 KW (2 units) 250 V 225# 25# g. BP modern design

ENGINE GENERATORS

60 cycle 3 phase

168 KW 2400 Ames Uniflow 150# with auxiliaries (new 1930)
190 KW 480 V Skinner Counterflow 150# with auxiliaries, good condition
200 KW 2400 V Ridgeway Uniflow 150# with auxiliaries (new 1926)
300 KW 208 V Y Skinner Uniflow 150# complete (new 1929)
450 KW 480 V Skinner Uniflow 150# ISP 0 to 20# g. BP (new 1922)
400 KW 480 V Allis Corliss 175# 150° ISP 25# (new 1924), excellent unit
500 KW 480 V Chuse vertical Uniflow 150# complete
600 KW 2400 V Chuse Uniflow 200# C or NC (new 1922)
800 KW 2400 V Skinner Uniflow 200# (new 1930) good unit

DC ENGINE SETS

200 KW (2 units) 250 V DC Hamilton Corliss left hand
600 KW 250 V DC 3-wire Skinner Vertical Uniflow 150# ISP 3" g. BP (new 1931) good condition

BOILERS

WATER TUBE

250 HP (3 units) 200# Stokers B&W Stirling (new 1921)
300 HP (5 units) 150# Grates for sawmill refuse. Wickes vertical
365 HP (2 units) 200# 100° Stokers Edgemoor str tube (new 1923)
550 HP (2 units) 165# 100° Oil fired Heine str tube (new 1922)
600 HP 200# B&W Stirling (new 1922)
1000 HP (2 units) 225# oil firing B&W Stirling (new 1925)
650 HP 400# 2-drum vertical bent tube (new 1930)

FIRE TUBE

90 HP 118# stoker equipped ASME Mich. Code HRT
190 HP 125# stoker equipped ASME Ohio Code HRT
200 HP (2 units) 115# stoker equipped ASME Code HRT
250 HP 125# grates and stack non-code Scotch Marine
100 HP (4 units) 200# oil firing Drilling boilers fire box type

DIESEL ENGINE GENERATORS

60 cycle 3 phase

400 KW/600 HP 480 V Clark 2 cycle vertical 400 RPM
375 KW/560 HP 2400 V Fairbanks Model 33, 257 RPM
540 KW/800 HP 480 V 4 cycle 6 cylinder 360 RPM new units
465 KW/700 HP 2400 V Fairbanks Model 33, 257 RPM
500 KW/740 HP 480 V Alco 514 RPM
250 KW/375 HP 240 V Alco 5 cylinder 360 RPM (new 1938)

250 V DC UNIT

200 KW/300 HP 250 V Worthington 327 RPM (new 1933)

POWER UNITS

180 HP Fairbanks Morse Model 32E12 (new unit)
225 HP Buckeye 6 cylinder 400 RPM complete (new 1941)

MOTOR GENERATORS

190 KW: 60/3/440 Synchronous, 25/80 V DC with exciters, panel, controls
500 KW: 60/3/4000 Synchronous, 250 V DC, all accessories
1500 KW: 60/3/2200 Synchronous, 250 V DC, with exciters, rehostats
3500 KW: 60/3/13200 Synchronous, 250 V DC, with exciters

ROTARY CONVERTERS

1000 KW: 60/6/13200 AC, 250# V# DC, with transformers

ARC RECTIFIERS

1000 KVA (2 units) 600 V DC Brown-Boveri. Specs available

FREQUENCY CHANGERS

500 KW 6/3/4160 Y—25/3/4160 Y needs reconditioning
1000 KVA (2 units) 60/3/2400—40/3/10,000 complete
1500 KW (2 units) 60/3/4160 Y—25/3/6900 Y complete start either end

TRANSFORMERS

100 KVA to 4000 KVA 69, 44, 33, 22, 13.2, 2.4 KV primaries

PAUL STEWART & CO., INC.

UNION TRUST BUILDING .. CINCINNATI 2, OHIO

Over 50 Years of Service

EIGHT AIR COMPRESSORS

Available For Immediate Shipment

2—1858 CFM Worthington Air Compressors, Type DC-2, size 23 x 14 x 14, 2-stage horizontal, 100# pressure, 277 RPM with after-coolers. Direct connected to 300 H.P., G.E. Syn. motor, 3/60/2300 volt, 8PF, complete with 5-step control and 5 KW MG set for excitation, 3/60/440. 125 volt DC output with starter and control panel. *Purchased new March, 1943. In excellent condition.*

4—3078 CFM Ingersol Rand Air Compressors, Type PRE, 18x30x21, 110# pressure, with after coolers and air receivers direct connected to 500 HP General Electric synchronous motor, 180 RPM, 3/60/220, .1 PF with 7½ KW MG set excitation and starting panel.

New 1942—in excellent condition

SCHRAMM AIR COMPRESSORS

2—Schramm gas driven air compressor. Displacement 315 and 210 CFM, at a working pressure of 100#. Portable mounted on pneumatic tires with a spare set of steel wheels complete and self-contained. *Purchased in 1945.*

TURBO-GENERATORS — MOTORS — WELDERS

GASOLINE DRIVEN POWER PLANT

1—35 KVA gasoline driven power plant, Hercules Motor Corp. engine, 4¼x4¾, Model WXLC-3, Serial #180572, with U. S. Motors Generator, Type M-7, 220-volt, 3 phase, 60 cycle, 1200 RPM, Serial #2981, complete self-contained with panelboard.

Has a center tap, 110 volts, single phase.

1—5000 KW Westinghouse Turbo-Generator, 3600 RPM, 200# pressure, condensing, 2300/3/60 complete.

1—710 HP Terry Turbine, 3600 RPM, 145# ISP, 0-60# BP, 18" x 18" centrifugal pump, rated 13,000 GPM, 170' head, 1000 RPM

1—50 KW Westinghouse Turbo-Generator, 200# pressure, 75 HP, 7200 RPM, geared to 50 KW, 125 V DC 1200

1—800 KW Westinghouse M-G set, Synchronous Motor, 1150 HP, 514 RPM, 13200/60/3, Generator 250 V DC with direct connected exciter

1—300 KVA Generator Set, Burke Alternator, 480/60/3, 200 RPM, direct connected to exciter and Skinner Uniflow, 150# ISP, 0-5# BP

1—1000 H.P. General Electric Slip Ring Motor, 6600/60/3, 600 RPM, with controls

1—700 H.P. General Electric, Type KF motor, 2300/60/3 1800 RPM

1—150 KW General Electric Alternator, Type ATB, Form B, .8 PF 480/60/3 600 RPM, 3 bearing, direct connected exciter

300 and 400 Ampere

ELECTRIC MOTOR DRIVEN ARC WELDERS

General Electric—Hobart—Lincoln

Reconditioned—Guaranteed
New 1943

CARRIER AIR CONDITIONING UNIT

1—30-ton Carrier Air Conditioning Unit, Complete including Kuthabar unit. Installed new in 1944. Used one season

---

MISCELLANEOUS

1—3600 sq. ft. CR. Wheeler Surface Condenser

2—12" LeCourtney Centrifugal bronze fitted pumps, 1800 RPM

1—20-ton ox Crane, hand operated, 39 ft. span, complete ½, ¾, 1, 1½ and 2 ton Chain Hoists, standard Lift ½, 1 and 1½ ton Electric Hoists, 3 ph. 60 cyc. 220/440 volt

Heat and Power Co., inc.

70 PINE STREET | WHITEHALL 3-2172 | NEW YORK 5, N. Y.

Be Wise! New Motors!

2,000 Amps. G. E. plating Generator Set 8 to 16 Volts	3–200 H. P. 1800 4 speed Wagner 3/60/440 Frame 31V 133 H. P. 1160 100 H. P. 870 67 H. P. 575	Allis Chalmers Sq. Ca. 3–200 Type ART 2200 V 900 R.P.M. 9– 50 H.P. G.E. TEFC 514 R.P.M.
3–50 H.P. A & C Slip rings 220/440/60/3 900 R.P.M.	Allis Chalmers 2–150 H. P. Drip Proof 3/60/440 V-3600 1–100 H. P. 3/60/440 V 3600 RPM 1–600 H. P. ANY wound motor 3/60/2200 V-600 RPM	65– 2 H.P.— 548 R.P.M. G.E. TEFC 10–20 H.P.— 420 R.P.M. Master TEFC

INVENTORY OF GEAR HEADS

Qty.	H.P.	R.P.M.	Qty.	H.P.	R.P.M.	Qty.	H.P	R.P.M.
3	1/2	30	1	1-1/2	39	3	3	45
2	1/2	45	2	1-1/2	45	2	3	68
2	1/2	110	3	1-1/2	110	1	3	99.2
7	1	59	2	1-1/2	151	90	1/15	172
2	1	88	2	2	68	1	60 Sq. Cg.	116
1	1	190	4	3	30	3	40 Slp	85
3	1	350	8	3	39	1	3	80
						22	3/4	148

NEW

CUTLER-HAMMER CONTROLS

QTY.	SIZE	VOLTS
37	2	220
14	2	440
3	3	220
19	1	440
8	1	220
29	(9586H 2385A)	Size 1 with disc.
6	(9586H 1800A)	Size 1 with disc.
8	(9591H 885A)	Size 1 with disc.
9	3	440
28	(9441HO	Size 1 with disc.
28	(10250H 2080A)	Start & Stop
100	Pushbuttons	
5	(9589H 1978)	Starter
6	(9586H 3020A)	with disc.
8	4	440

COMPENSATORS

50 HP 220 V	100 HP 440 V
50 HP 440 V	125 HP 220 V
100 HP 220 V	150 HP 440 V

NEW

STANDARD OPEN SQUIRREL CAGE 3/60/220-440 B. B.

Qty.	H.P.	Frame	R.P.M.
6	75	5084	1200
4	100	5084	1800
1	125	5085	1800
3	125	6085	1200
1	150	5085	1800
4	150	6085	1200
1	200	6085	1800
2	200	6085	1200

NEW

TOTALLY ENCLOSED FAN COOLED 3/60/220-440 B. B.

Qty.	H.P.	Frame	R.P.M.
4	75	508	1200
3	100	508	1800
2	100	508	1200
2	125	6085	1800
2	125	6085	1200
2	150	6085	1800
2	150	6085	1200

We have in stock 10001 items, too numerous to list • Controls • MG sets Slip Ring Motors • Oil Switches, etc. • We can serve you best if we know what your requirements are.

We invite your inquiries.

The Above Subject to Prior Sale

WRITE-WIRE-PHONE YOUR INQUIRIES TO

Electric Motor & Machinery Co.

MONROE 1388-1389 P.O. BOX 1273 ROCHESTER 7, N. Y.

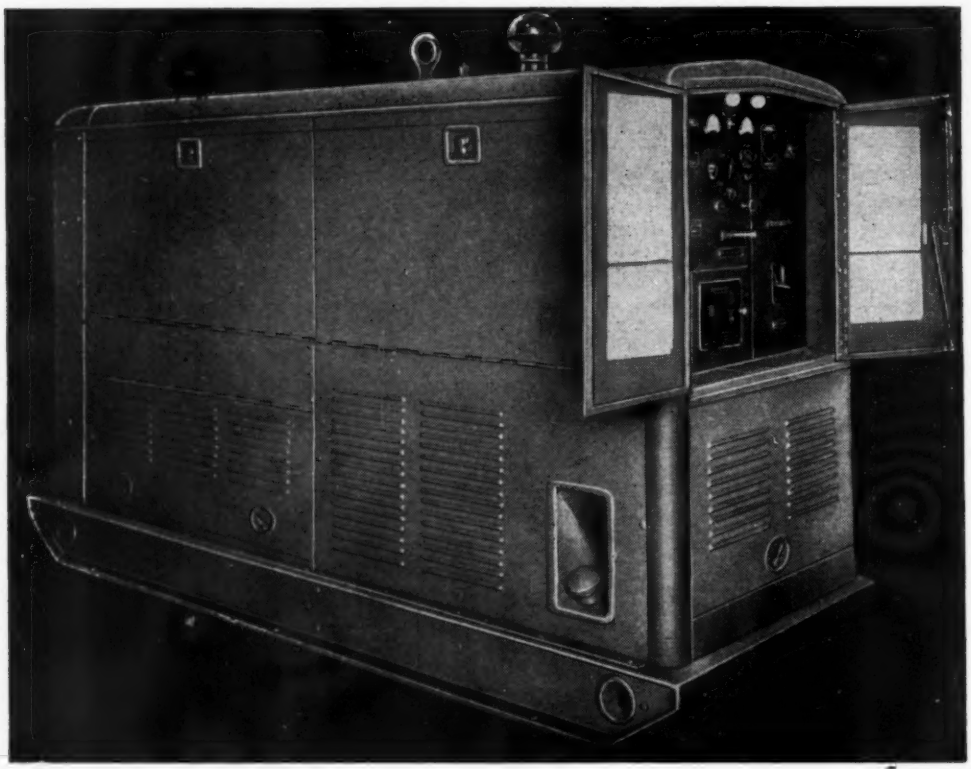
1132-38 MT. HOPE AVE.

DIESELS Thats all!

DIESELS Thats all!

PORTABLE GENERATOR SETS

DIESEL AND GASOLINE
ALTERNATING CURRENT



3 — 5 — 7½ — 10 — 15 — 30 — 50 KW

Also

LARGE STATIONARY PLANTS

DIESEL MOTORS CORPORATION

PORT WASHINGTON, LONG ISLAND, N. Y.
ROSLYN 1600.

DIESELS Thats all!

DIESELS Thats all!

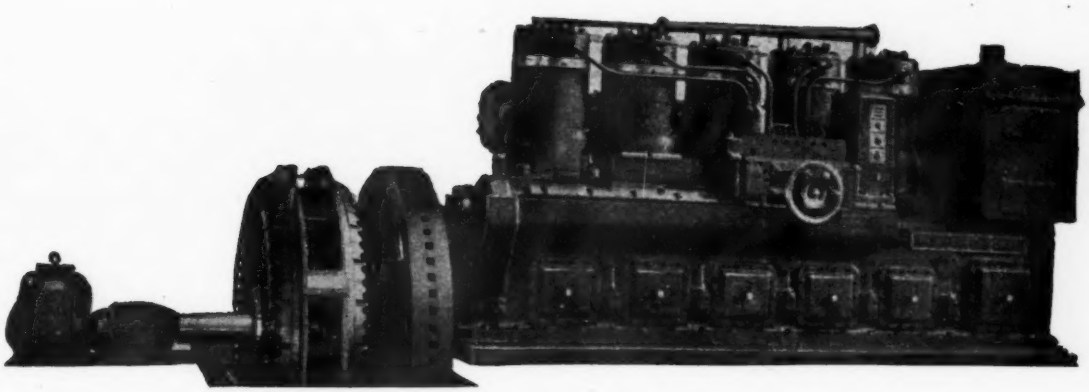
DIESELS That's all!

DIESELS That's all!

450 H. P. FAIRBANKS MORSE

380 K.V.A. DIESEL POWER PLANT

Latest Model 33—240 Volt



OTHER IMPORTANT OFFERINGS—PROMPT DELIVERY

HP	Model	KVA	RPM	New
6—1600	General Motors	1200	720	90%
2— 900	Alco 540	750	600	95%
2— 600	Fairbanks 32F	500	400	99%
1— 450	Fairbanks 32E	375	360	85%
1— 375	McIntosh Seymour	375	360	85%
1— 350	General Motors 8-268A	250	1200	85%
1— 150	General Motors 3-268A	125	1200	85%
1— 360	Fairbanks YVA	300	257	80%
1— 240	Fairbanks YVA	200	257	75%
2— 450	Buckeye "80"	375	600	100%
1— 300	Buckeye "E"	250	400	98%
1— 300	Buckeye "80"	250	600	100%
4— 225	Buckeye "80"	187	600	New
1— 225	Buckeye "E"	187	400	98%
1— 190	Buckeye "J"	125	514	98%
1— 112	Buckeye "E"	94	400	98%

Running Inspection on Original Foundations

DIESEL MOTORS CORPORATION

PORT WASHINGTON, LONG ISLAND, N. Y.

ROSLYN 1600.

DIESELS That's all!

DIESELS That's all!

WE HAVE SOLD MANY OF THESE WAR-BUILT MARINE STEAM GENERATORS—

The "9-Marine Boilers" which we advertised in July 1946 POWER all went to Stationary Plants in the U. S., Mexico and Brazil. Since then we have sold similar MARINE STEAM GENERATORS for stationary land use in the U. S. and China. Our last 3-months' sales of MARINE STEAM GENERATORS and auxiliaries amount to $339,200.00.

Why do buyers favor these MARINE STEAM GENERATORS for their stationary installations? Here are several good reasons: (a) *practically immediate deliveries*—they have felt that their present projects should not be further delayed by waiting for many months for boilers to be manufactured; (b) *saving of money*—since they purchased these units of us at very much less than their original cost—thus a reduction in their HP capital investment; (c) *they are steel-encased*—requiring no brick-work—a saving of time and money; and (d) *modern, high quality STEAM GENERATING UNITS*—built during the war for the U. S. in 1942-1943 of the finest steels by such outstanding manufacturrs as Combustion Engineeering Corp., Babcock and Wilcox, Foster Wheeler Corp. and Edge Moor Iron Works from the latest modern plans under Navy, Maritime and U. S. Coast Guard specifications and inspections.

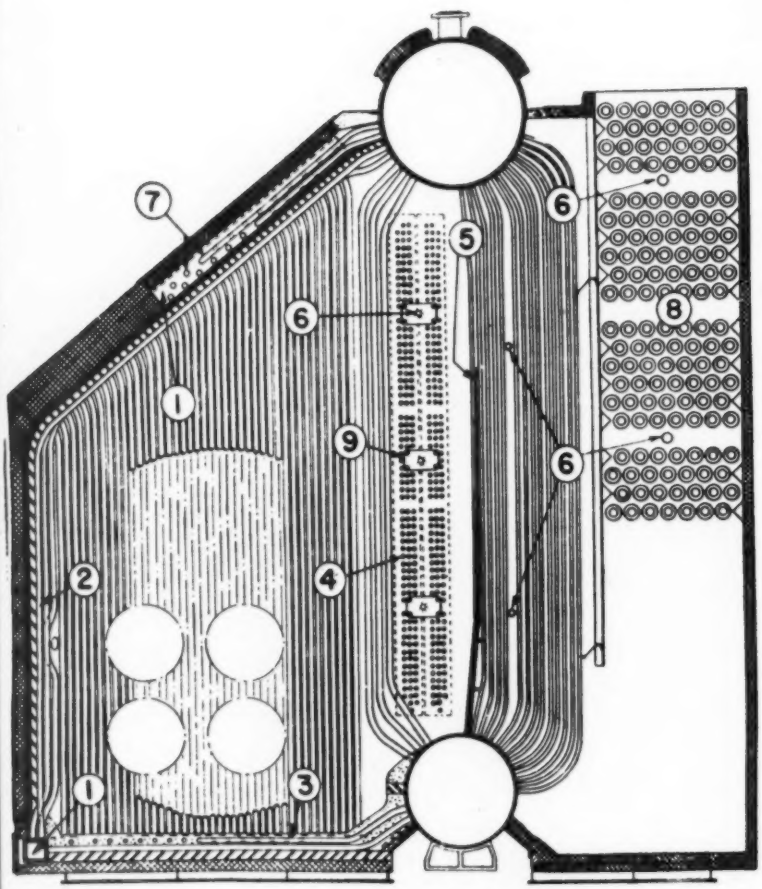


FIGURE No. 1

TRANSVERSE SECTION THROUGH BOILER

1. Water Wall Headers
2. Water Wall Tubes
3. Floor Tubes
4. Superheater
5. Baffles
6. Soot Blowers
7. Water Wall Connector Tubes
8. Economizer
9. Soot Blower Support

NO. 1

This is the first of three (3) types and sizes of steel encased fully erected MARINE STEAM GENERATORS WHICH WE HAVE AVAILABLE AT THIS TIME.

FOUR (4) Type "D" MARINE STEAM GENERATORS built by FOSTER WHEELER CORP. FOR THE U. S.

DESCRIPTION OF STEAM GENERATOR

This "D" type Steam Generator consists of a two drum, bent tube Boiler section, Waterwalls, Superheater, and Economizer.

The Boiler section consists of a Steam Drum and a Water Drum connected by a vertical bank of tubes. The two Drums are also connected by Water Cooled Furnace Wall Tubes, the Furnace being water cooled on sides except the front wall. The furnace is fired by four Todd Oil Burners located in the front wall of the Furnace.

The Superheater is located in the tube bank three rows of tubes back from the furnace and consists of U-bend elements rolled into vertical Headers.

The Economizer is of the extended surface type placed after the last pass of the Boiler.

The Economizer is 20 tubes high and seven tubes wide arranged four to carry.

The Boiler Tube Bank is baffled to make the gases flow up over the Boiler surface and the Superheater in the first pass, then down over the tubes in the second pass leaving the Boiler at the bottom. The gases then flow upward through the Economizer and thence to the Stack.

FOR STATIONARY INSTALLATIONS

NO. 2

FOUR (4) Type "DE" MARINE STEAM GENERATORS built by BABCOCK & WILCOX FOR THE U. S.

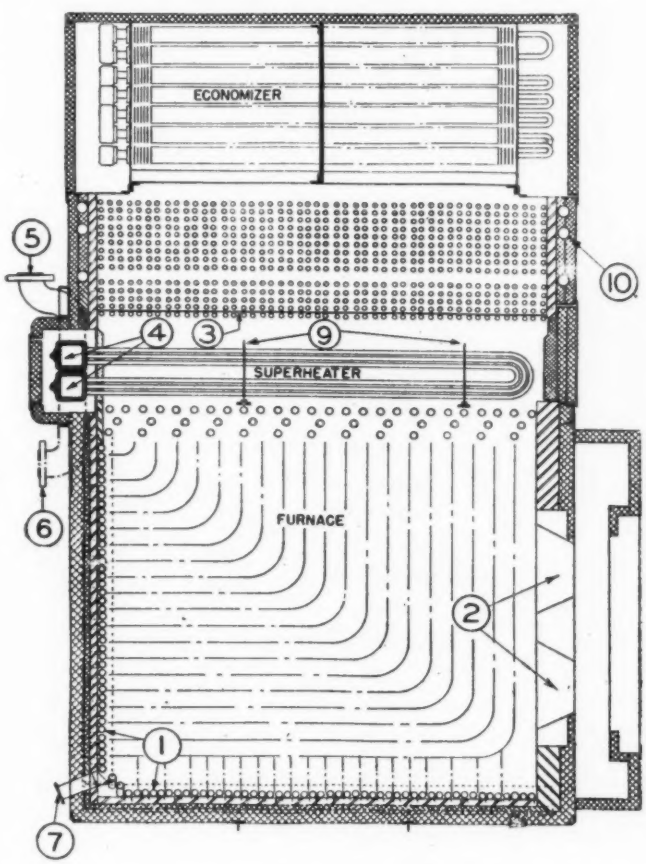
2-Drum, Bent Tube Type, steel encased, fully erected. Complete with Oil Burners, Economizer, Superheater and Trimmings.

SPECIFICATIONS

Boiler and Water Walls (sq. ft.)	4110
Superheater (sq. ft.)	1113
Economizer (sq. ft.)	3570
Furnace Volume (cu. ft.)	1040
Steam Pressure - Superheater Outlet (lb. sq. in.)	465
Steam Temp. at Superheater Outlet (deg. F)	765
Feed Temp.-Economizer Inlet (deg. F)	240
Gas Temp. to Stack (deg. F.)	280

CAPACITIES, LB. PER HOUR:

Superheater Steam, normal	36500
Desuperheated Steam, normal	2000
Superheated Steam, maximum	55000
Desuperheated Steam, maximum	10000



HORIZONTAL SECTION THROUGH LOWER PART OF BOILER

1. Waterwall Tubes
2. Burner Opening
3. Baffle
4. Superheater Headers
5. Superheater Inlet
6. Superheater Outlet
7. Peephole
8. Economizer Support Plate
9. Superheater Support Plate
10. Downcomer Tubes

DESIGN DATA

Pressure lb. sq. in at Normal Power:	
Design	475
Steam Drum	455
Operating (Superheater Outlet)	435
Temperatures, deg. F. at Normal Power:	
Final Steam Temperature	740
Superheat	284
Steam Temp. at Desuperheater Outlet	510
Feedwater Temp to Economizer	225
Feedwater Temp. from Economizer	298
Heating Surface:	
Boiler Heating Surface	2344
Water Wall Heating Surface	97
Superheater Heating Surface	337
Economizer Heating Surface	835
Furnace Volume, cu. ft.	330
Design Evaporation Rate (Normal Power):	
Desuperheated Steam (Lb. per hour)	10500
Superheated Steam (Lb. per hour)	49500
Total Steam (Lb. per hour)	60000

ASK FOR PRICES AND FURTHER INFORMATION

NO. 3

FOUR (4) Type #54-S MARINE STEAM GENERATORS built by FOSTER WHEELER CORP. for the U. S.

Cross Drum, Straight Tube Type, with Sectional Headers (12 sections wide). Complete with Mud Drum, Superheater, Oil Burners, Trimmings, etc.

Brand new and knocked-down.

Indicated Horsepower	250
Desuperheated Steam (Normal, lb. pr. hr.)	8300
Superheater Steam (Normal, lb. pr. hr.)	12500
Total Steam (maximum) lb. pr. hr	18500
Steam Temp. at Superheater Outlet (Normal (deg. F.)	494
Furnace Volume (cu. ft.)	193
Design Pressure (sq. inch)	236
Op. Pr. at Sup. Outlet (sq. inch)	190
Boiler Heating Surface (sq. ft.)	2000
Economizer Heating Surface (sq. ft.)	646

ASK FOR PRICES AND FURTHER CONFORMATION

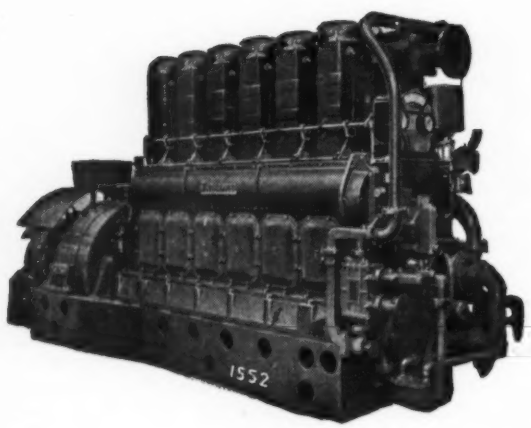
J. PARKER THOMPSON CO., INC.

POWER EQUIPMENT

507-FIFTH AVE. **NEW YORK** **MURRAY HILL 7-6547-8-9**

DIESEL GENERATORS

DIRECT CURRENT



8—250 KW Diesel Generators, 3-Direct-Current 120/240 volt, 3-wire

Each direct connected to

8—450 HP Enterprise, diesel engines, Type DSG-6, 450 RPM, 6 cylinder, 12" bore x 16" stroke

COMPLETE EQUIPMENT

BRAND NEW

OTHER DIRECT CURRENT OFFERINGS — IMMEDIATE DELIVERY

KW	VOLTS	MAKE	HP	MODEL	RPM	YEAR
3—500	120/240	General Motors	750	8-278-A	720	New
2—300	120/240	General Motors	450	6-278-A	750	New
6—275	120	Cooper Bessemer	440	FS-8	800	New
2—250	120/240	Enterprise	450	DSG-8	450	New
3—100	120/240	Superior	150	GDB-8	1200	New
1— 90	120	Winton	140	144	1200	1939
2— 60	120	General Motors	90	6-71	1200	1943
3— 15	120	Hill	30	4 C	1200	1940
2— 12	120	Hill	25	4 R	1200	1939
2— 10	120	Hill	20	4 R	1200	1940

WRITE—WIRE—PHONE

80,000 DIESEL HORSEPOWER FOR IMMEDIATE SHIPMENT

A. G. SCHOONMAKER COMPANY INC.

DIESEL ENGINES
POWER CONSTRUCTION EQUIPMENT

Established 1898

50 CHURCH ST., N. Y. 7, N. Y.

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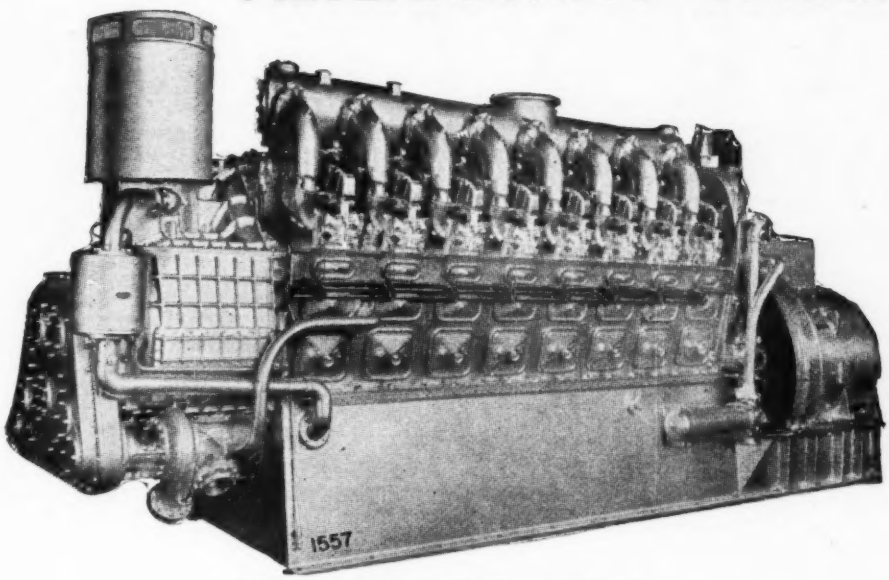
Cable Address Agscomach.

DIESEL GENERATORS

ALTERNATING CURRENT



1000 KW, 1250 KVA GMC Diesel Generator

SIXTEEN GENERAL MOTORS 1000 KW UNITS

1000 KW, 1250 KVA Electric Machinery Mfg. Co. alternator, 3/60/2400, 720 RPM, direct connected to—

1600 HP General Motors Corp. Diesel engine, Model 16-278A, 2 cycle, 16 cylinders, V type, 8¾" x 10½", 720 RPM

(See below)

OTHER IMPORTANT OFFERINGS FOR QUICK DELIVERY ! !

KW	MAKE	H.P.	MODEL	RPM	YEAR
2—1500	Fairbanks Morse	2000	33E16	300	1939
1—1000	Nelseco	1500	6M1-53	300	1931
*16—1000	General Motors	1600	16-287-A	720	1944
2— 800	General Motors	1200	16-278-A	600	1944
1— 500	Superior	750	OS	327	1938
1— 300	General Motors	450	6-278-A	600	New
2— 250	Enterprise	450	DSG-6	450	1945
1— 240	Fairbanks Morse	360	YVA	257	1928
*3— 200	General Motors	300	8-268-A	900	New
6— 200	General Motors	400	8-268-A	1200	1945
1— 125	Buckeye	190	70	514	1941
5— 100	General Motors	200	3-268-A	1200	1944
1— 75	Buckeye	112	E	400	1936
8— 60	General Motors	90	6061E	1200	New
15— 50	International	75	UD18	1200	New
8— 30	International	45	UD14	1200	New

80,000 DIESEL HORSEPOWER FOR IMMEDIATE SHIPMENT

WRITE FOR BULLETINS

A. G. SCHOONMAKER COMPANY INC.

DIESEL ENGINES
POWER CONSTRUCTION EQUIPMENT

Business Est. 1898

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THE PICK OF POWER EQUIPMENT

TURBINE UNITS—60 Cy.
1—22500 KW General Electric Cond.
1—18300 KVA Westinghouse Cond.
1— 5000 KVA General Electric Cond.
1— 3750 KVA Westinghouse Extrac.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1875 KVA Westinghouse Cond.
1— 1875 KVA Westinghouse Non-C.
1— 1563 KVA Westinghouse Extrac.
2— 1250 KVA General Electric Cond.
1— 375 KVA General Electric Cond.

D. C. TURBO UNITS
1—250 KW Westinghouse, 120/240 V.
1—125 KW General Electric, 125 V.
1— 75 KW General Electric, 125 V.
1— 50 KW Westinghouse, 125 V.

STEAM ENGINE UNITS—60 Cy.
1—900 KW Hamilton Uniflow
1—625 KVA Ames Uniflow
1—500 KVA Chase Uniflow
2—480 KVA Skinner Uniflow
1—375 KVA Harrisburg Uniflow
1—325 KVA Skinner Uniflow
1—300 KVA Skinner Uniflow
1—150 KVA Ames Uniflow

D. C. STEAM ENGINE UNITS
1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—250 KW Ames Uniflow 250 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire

DIESEL ENGINE UNITS
2—1600 HP Gen. Motors, 2400 V. 60 cy. gen.
1— 625 HP Worthington, 240 V. 60 cy. gen.
1— 440 HP Nordberg, 250 V. gen.
2— 400 HP LeRoi RX1SV (gasoline) eng. only
1— 375 HP McInt. & Sey., 240 V. 60 cy. gen.
1— 300 HP McInt. & Sey., 480 V. 60 cy. gen.
2— 250 HP Gen. Motors, 460 V. 60 cy. gen.
1— 150 HP Buckeye 400 RPM engine only
2— 125 HP Winton, 240 V. 60 cy. gen.

WATER TUBE BOILERS
2—1409 HP B. & W. 650-lb., Stokers
1—1320 HP Springfield 400-lb., Pulverizer
1— 807 HP Wickes 250-lb., Stoker
2— 600 HP Springfield 200-lb., Stokers
2— 560 HP Erie City 460-lb.
5— 492 HP Heine 180-lb., Stokers
2— 481 HP Springfield 225-lb., Pulverizer
2— 469 HP B. & W. 425-lb., Pulverizers
2— 323 HP Springfield 225-lb., Stokers

SYNCHRONOUS MOTORS
1—300 HP West. 60 cy. 2300 V. 720 RPM (NEW)
1—200 HP Ideal 60 cy. 4000 V. 514 RPM
2—200 HP Burke 60 cy. 2300 V. 900 RPM
1—100 HP G.E. 60 cy. 2300 V. 240 RPM (Super)
1—100 HP G.E. 60 cy. 4000 V. 1800 RPM

INDUCTION MOTORS—60 Cy.
1—1000 HP West. slip ring 2200 V. 300 RPM
1— 700 HP G.E. sq. cage 2200 V. 1800 RPM
1— 500 HP G E. slip ring 2200 V. 3600 RPM
1— 400 HP G.E. sq. cage 2200 V. 600 RPM
1— 250 HP F.-M. slip ring 220 V. 1800 RPM
2— 120 HP G.E. sq. cage 220 V. 3600 RPM

MOTOR GEN. SETS—60 Cy.
1—1500 KW Allis Chalmers 600 V. DC. 60 Cy.
1—1000 KW General Electric 600 V. DC. 60 Cy.
1— 400 KW Allis Chalmers 275 V. DC. 25 cy.
2— 300 KW Allis Chalmers 275 V. DC. 25 cy.
1— 300 KW Westinghouse 250 V. DC. 60 cy.
1— 250 KW Allis Chalmers 275 V. DC. 25 cy.
1— 100 KW Westinghouse 125 V. DC. 60 cy.
1— 50 KW Westinghouse 250 V. DC. 60 cy.

ROTARIES—60 Cy.
1—2000 KW Allis Chalmers 600 V.
1—2000 KW General Electric 600 V.
1—2000 KW West. 250 V. 3-wire, 25 cy.
2—1750 KW General Electric 250 V.
1—1500 KW General Electric 600 V.
1—1500 KW Westinghouse 250 V.
1—1000 KW Allis Chalmers 600 V.
1— 750 KVA General Electric 600 V.
1— 500 KW General Electric 250 V.

FREQUENCY CHANGERS
1—2150 KVA G.E. 25/62½ cy. 750 RPM
1—1875 KVA G.E. 25/60 cy. 300 RPM
1—1250 KVA West. 25/60 cy. 300 RPM
2—1000 KVA G.E. 25/60 cy. 300 RPM
1—1000 KVA Al. Ch. 25/62½ cy. 375 RPM
1— 938 KVA West. 25/62½ cy. 750 RPM
1— 600 KVA G.E. 60/25 cy. 300 RPM

TRANSFORMERS—1 Ph. 60 Cy.
4— 6667 KVA G.E. 79660/138,000-34500 V.
3— 2500 KVA Moloney 63/110Y-23/11.5 KV
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
4— 1500 KVA G.E. 66-13.2/4.6/2/3 KV
3— 750 KVA Pitts. 66000-33000 V.
4— 333 KVA Al. Ch. 44000-13200/23000Y V.
4— 1500 KVA G.E. 33-13.2/4.6/2.3 KV
3— 150 KVA G.E. 33000-11000 V.
3— 50 KVA G.E. 33000-2300 V.
2—10000 KVA West' 26400-4580 V. 3 ph.
1— 600 KVA West. 26400-2300 V. 3 ph.
2— 4000 KVA Pitts. 26400-13200 V. 3 ph.
3— 4000 KVA G.E. 27600-13800 V.
2— 1000 KVA G.E. 23000/11500-575 V.
1—10000 KVA West. 13200-4580 V. 3 ph.
1— 5000 KVA West. 13200-480/220 V. 3 ph.
2— 1000 KVA G.E. 11500/23000-575 V.
1— 300 KVA West. 450-100 V. (Furnace)

OIL CIRCUIT BREAKERS
2— 400 A. 37 KV G.E. FHK0136 Outdoor
2—1000 A. 30 KV Kelban CB76 Outdoor
3— 400 A. 25 KV G.E. FK0136 Outdoor
4— 600 A. 15 KV G.E. FHK0139-24BS Outdoor
1— 600 A. 15 KV G.E. FK037 Pole Type
1— 600 A. 15 KV West. 0-221 Outdoor
2— 400 A. 15 KV G.E. FHK0136 Outdoor

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Special Offerings

TURBO-GENERATORS
1—3000 KW. 600 V. Ext. Cond.
1—2500 KW. 2300 V. Cond.
1—1250 KW. 2300 V. Cond.
1—2000 KW. 600 V. Cond.
1—1250 KW. 480 V. Cond.
1—1000 KW. 2300 V. Cond.
1— 750 KW. 480 V. N.C.
1— 625 KW. 2300 V. Cond.
1— 500 KW. 600 V. N. C.
1— 500 KW. 600 V. Cond.
1— 500 KW. 240 V. Cond.
2— 100 KW. 115 V. DC. N.C.

ENGINE GENERATORS
2—600 KW. 2300 V. Uniflow
1—400 KW. 440 V.
1—168 KW. 600 V.
1—250 KW. 480 V.
1—150 KW. 480 V.
2— 96 KW. 220 V. Uniflow

TURBINES ONLY
1—375 H.P. with gears
1—210 H.P. Terry 250#
5— 56 H.P. 1600 RPM, new

BOILERS
1—1390 H.P. 400# Coal
1— 990 H.P. 200# Coal
1— 620 H.P. 200# Coal
3— 500 H.P. 160# Coal
1— 360 H.P. 190# Coal
2— 310 H.P. 250# Coal
2— 100 H.P. 100# Oil
2— 175 H.P. 200# Oil
1— 200 H.P. HRT 160#

AIR COMPRESSORS
2—3400 CFM 100# Motor
1—3000 CFM 100# Motor
1—1972 CFM 100# Motor
1—1573 CFM 100# Motor
1—1330 CFM 50# Steeam
1—1700 CFM 100# Steam
1— 600 CFM 350# Steam
1—5000 CFH 600# BeBlted
1—1000 CFH 3000# Belted

PUMPS
1—Vacuum, Size 14"x22"x24" Steam Driven
1—3000 GPM 65' Head, Motor Driven
1—600 GPM, 162' Head Motor Driven

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The buyer Must Be Satisfied—Always

POWER EQUIPMENT
1—150 K. W. 125 volts 400 RPM Crocker-Wheeler compd wound interpole Generator to a 4 cylinder, vertical unaflow Ames engine.
1—360 HP Anderson full diesel, Model 29, 257 RPM with clutch and pulley on one end to drive an ice machine or any other machine and a 125 KVA, 3 phase, 60 cycle, 240 volt Generator direct connected on opposite end.
1—90 KVA, 3 ph., 60 cy., 2300 V, Fairbanks Morse Generator connected to a 2 cylinder Fairbanks Morse full diesel type Y, style VA.
1—156 KVA., 3 ph., 60 cy., 240 volt, 1200 RPM, type ATB frame 9635 General Electric connected to an 8 cylinder Buffalo Gasoline engine.
1—1000 K.W. 3 ph., 60 cy., 480 volt, 3600 RPM, General Electric Generator to a General Electric turbine 190 lbs steam pressure 40 lbs back pressure.
1—500 KW, 3 ph., 60 cy., 2300 vlt. 3600 RPM General Electric non-condensing Turbo Generator.
1—300 KW, 3 ph., 60 cy., 440 vlt. 3600 RPM Westinghouse Generator only.
7—500 amp. 6 V direct current to 3 ph., 60 cy., 220 vlt. General Electric rectifiers.
1—750 KW Gen. Elec. Extraction type Turbine 3 ph., 60 cy., 600 vlt. 150-175 lbs., 10 to 20 lbs. extraction.
1—100 KW. 125 V. type CD1247 General Electric to a 150 HP 3 ph., 60 cy., 220 vlt. type K5572 Gen. Elec. induction motor.
1—125 KW, 125 V. type CD1348 General Electric to a 3 ph., 60 cy., 220 V. type TS9647 General Electric syn. motor.
1—50 KW, 250 volt Gen. Elec. to a 75 HP, 3 phase, 60 cycle, 440 Vlt. General Electric motor.
A large number of new 115 volt direct current ball bearing General Electric motors 5 to 20 HP.
1—1500 KW, 250 vlt., 600 RPM Westinghouse rotary converter complete with transformers and switchboard.
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(MOST EQUIPMENT 3 TO 4 YEARS OLD)

BOILERS

6—Express Boilers, modified D type, Foster Wheeler, 30,000# steam hr, 435# press., with economizers, superheaters, desuperheaters, oil burners etc.

CROSS COMPOUND TURBINES

2—Bethlehem 25,000 SHP each
2—General Electric 13,500 SHP each
Each turbine consists of a HP, LP, and astern element. Units can be furnished complete with gear reducers, condensers, pumps, luboil purifiers etc.

TURBO—GENERATORS

2—4600 KW G.E. 3 phase, 93 1/3 cycle, 2700 V, 5600 RPM (or 2900 KW, 60 cycle, 1700 V, at 3600 RPM), 410# cond., complete with 3800 sq. ft. condensers, amplidyne motor generators, circulating and condensate pumps, etc.

9—300 KW G.E. type ATI 3/60/450, 1200 RPM, 400# cond., compl. with 40 KW exciters, condensers, switchboards.

8—200 KW G.E. type ATB 3/60/450, 1200 RPM, 375# cond.
2—132 KW G.E. type ATB 3/60/450, 1200 RPM, 540# cond.
1—540 KW West'hse, 180 V, DC, 3000 Amp, 1200 RPM, 200#
1—300 KW 120/240 V.D.C. 1200 RPM 440# cond.
12—150 KW West'hse, type SK, 120 V, DC, 1200 RPM, 225# cond.
20— 60 KW West'hse type SK, 120 V, DC, 1800 RPM, 200# cond.
NOTE: All AC generators are complete with exciters. Condensers, switchgear and other auxiliaries can be furnished.

DIESEL—GENERATOR

1—80 KW G.E. type ATI 3/60/450, 1200 RPM, with exciter, driven by Fairbanks Morse model 36A 8 cyl. 4 cy. diesel; complete with switch gear, oil pumps and purifier.

MOTOR—GENERATORS

AC to DC and DC to AC—various sizes from 40 HP to 1 HP.

GENERATORS

28—1200 KW DC Allis Chalmers, 525 V, 750 RPM

MOTORS

6—AC 25 HP, Star, 3/60/440, 1750 RPM, type NL3651
28—DC 1500 HP, W'hse, 525 V, 600 RPM
5—DC 25 HP, 35 HP, 50 HP, type CO 1809, 230 V all variable speed 550 RPM to 2100 RPM
500—DC, from ½ HP to 60 HP, 120 V, various speeds

18—General Electric AC synchr. motors, 3 phase, 6000 HP, 93 1/3 cycle, 2700 V, 400 RPM, or 3800 HP, 60 cycle, 1700 V, 257 RPM

SWITCHBOARDS

All sizes, AC and DC, whole or in parts, circuit breakers, current transformers, switches, meters, recorders etc. etc.

DIESEL ENGINES

2—350 HP Superior diesels 600 RPM type VDMB, 8 cyl.

TURBO-BLOWERS

4—West'hse type 56 ANV, 56,000 CFM at 10" S.P. turbine 168.5 HP, 540# steam
9—Sturtevant size 24—20,000 CFM at 17" S.P. turbine 191 HP, 400# steam

CONDENSERS

2—4568—⅝" tubes—surface 8408 sq. ft.
10—4500—⅝" tubes—surface 8463 sq. ft.
10— 400—⅝" tubes—surface 280 sq. ft.
1— 714—⅝" tubes—surface 700 sq. ft.

FEED WATER HEATERS

1—Bath Iron Wks, 95# press. 546 sq. ft.
2—Bethlehem 415 sq. ft.
10—Schutte & Koerting type L, 300 sq. ft.
12—Struth. Wells, 6 pass, H.P., 206 sq. ft.

FUEL OIL HEATERS

24—Griscom Russell sect. G-fin, 86 sq. ft.
1—Griscom Russell 4 sect., 6 fin.

BOILER FEED PUMPS, TURBINE DRIVEN

1—DeLaval 675 GPM 725# dischge., 4900 RPM, steam 540#
1—DeLaval 600 GPM 575# dischge., 4600 RPM, steam 400#
2—Worth'ton 750 GPM 375# dischge., 3500 RPM, steam 240#
5—Ing. Rand 165 GPM 575# dischge., 4650 RPM, steam 375#
3—DeLaval 125 GPM 575# dischge., 7000 RPM, steam 400#

CENTRIFUGAL PUMPS

60—Various sizes up to 15,000 GPM, up to 725# disch. pr. steel and bronze, motor and turbine driven.

RECIPROCATING STEAM PUMPS

50—Simplex and duplex, various sizes, bronze and steel

REDUCTION GEARS

3—Sturtevant des. VB-14-G, 133 HP, RPM 5720:1550

TRANSFORMERS

5—50 KVA, 3—10 KVA, 15—25 KVA, 5— 3 KVA, 15—20 KVA — from 440 V to 120 V all single phase, 60 cycle, dry type

CENTRIFUGES

15—Sharples, 15—DeLaval — Oil purifiers and oil clarifiers, capacity 100 GPH and 150 GPH, with motors and pump

HIGH PRESSURE AIR COMPRESSORS

2—Ingersoll Rand type 40, 4 stage, 3000# press. 20 cft. driven by G.E. 3/60/220/440 motors 50 HP
1—same, driven by Waukesha gas engine model GBZ 1111
4—Platt, 4 stage, 20 cft., 3000# press., steam or motor drive

DISTILLING PLANTS

2—Griscom Russell Soloshell double effect, 8000 gals. per 24 hours, complete with pumps.
3—Cleaver Brooks Co., 5000 gals. p. day, self contained units complete with boiler pumps and fans.

HOISTS

6—Mead Morrison Co., 2 drum hoisting engines type H-87, driven by 51 HP G.E. motor 230 V, DC
5—Mead Morrison Co., single drum derrick swingers type 138, driven by 5 HP G.E. motor 230 v, DC
NOTE: the above hoists are complete with controllers.
2—Jaeger Utility hoists, single drum, driven by Continental 6 cylinder gasoline engine.

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M-G SETS

250 KW Gen. Elec. MPC gen. DC 250 V. coupled to 375 HP G.E. motor 3/60/2200 or 440 V., 1200 RPM, 3 brg. unit.
225 KW G.E. MPC gen. DC 125 V. coupled to 350 HP Whse. synch motor 3/60/440 V. 900 RPM.
150 KW Gen. Elec. type MPC gen. DC 125 V. coupled to 225 HP sq. cage motor 3/60/2200 V. 1200 RPM, 2 brg.
50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80 HP C-W motor sq. cage 3-60-220/440.
40 KW Martin rotary converter, input 3/60/220 v., output DC 230 v., with panel.
37½ KVA Whse. AC gen. 3/60/240 V. coupled to 50 HP Whse. SK motor DC 230 V. 1150 RPM, 3 brg.

Others available—special units built to order.

SPECIAL — 8 — 400 amp. Hobart Arc Welders 220/440 V. AC Drive.

D. C. MOTORS

H.P.	Mfg.	Type	Volts	Speed
125	Cr. Wheeler	125H	230	500
100	Gen. Elec.	BRC	115	1150
75	Cr. Wheeler	125H	230	350/750
75	Whse.	S136	125	475
75	Gen. Elec.	DLC	230	400
65	G.E. Northern	C	230	375/750
60	Diehl dynamom.	R10	250	500/2000
50	Whse.	SK	230	1150
50	G.E. Sprague	LC	250	700
50	Whse.	SA	230	450/1350
50	Cr. Wheeler (5)	50H	230	700
40	Gen. Elec.	LC	230	500/1200
40	Whse.	SK153	230	575/1150
40	Roth	S	115	850
35/50	Gen. Elec.	CD123	230	575/1150
30	Sprague	dynamom.	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
25	Whse.	SK	230	950
25	Sprague dyna.	IC	115	700/1500
25	Gen. Elec.	FFC32	230	800
25	Star b.b.	SB15	230	1750
20	Imperial int. dty.	D37	230	1200
20	Gen. Elec.	LC	230	575
20	Gen. Elec.	DLC	230	500/1500

SLIP RING MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qu.	H.P.	Mfg.	Type	Speed
1	400	Gen. Elec. 3 brg.	I-P	450
1	300	Burke	EMV	225
1	250	Cr. Wheeler	SR	600
1	200	G.E. 2200 v.	I-M	360
1	150	G.E. 2200 v. vert.	I-M	1200
1	75	G.E. 2200 v.	I-M	1800
1	75	F. Morse 2200 v.	BV	1800
1	60	Gen. Elec.	I-M	720
1	50	Whse.	MW332	900
1	50	Gen. Elec.	I-M	600
1	50	G.E. 2 phase	I-M	900
1	50	F. Morse b.b.	HV	1200
1	40	Gen. Elec.	M546	514
2	40	Allis Ch.	ANY	450
1	40	G.E. 550 v.	MT536	900
1	37	G.E. int. duty	ITC	600
2	35	Lancashire b.b.	late	1800
1	35	Whse. int. duty	CW	900
2	30	Allis Ch.	ANY	900
1	25	G.E. 2200 v.	I-M	900
1	25	F. Morse b.b.	HV	600
1	25	Gen. Elec.	MT322	1200
1	25	Gen. Elec.	I-M	600
1	20	Burke	EMV	1200
1	20	Wagner	19TRS	900

SYNCHRONOUS MOTORS

H.P.	Mfg.	Type	Volts	Speed
750	Allis Ch.		220/400	1200
300	Whse.	ped.	220/440	900
200	Elec. Machy.		220/440	600
150	Elec. Machy. New	8PF	220/440	360
100	Gen. Elec.	ATI	220/440	1200
50	Gen. Elec.	TS	220/440	900

AIR COMPRESSOR — 14x12 Ing. Rand 500 CFM, 100#, with Tank—BARGAIN

CENTRIFUGAL PUMPS
8" Alberger, 2000 gpm @ 80 ft.
6" Platt, 1000 gpm # 230 ft.
8" Worthington, 2000 gpm @ 200 ft.

SQUIRREL CAGE MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
3	165	Gen. Elec.	I-K	1800
1	75	Gen. Elec. 2200 v.	I-K	720
1	75	F. Morse b. b.	H	900
1	60	Wagner	BW	1200
1	60	Gen. Elec.	I-K	3600
2	50	Whse. 2200 V. vert.	CS	900
1	40	Gen. Elec.	I-K	900
1	40	F. Morse b. b.	H	720
1	30	Allis Ch. 2200 V.	AR	900
1	30	Wagner	BW	900
1	30	Gen. Elec.	I-K	720
1	25	Gen. Elec.	I-K	600

25 CYCLE MOTORS

H.P.	Mfg.	Type	Speed
450	Whse. 2200 v.	CW sl. rg.	750
150	Whse.	HD sl. rg.	500
100	Whse.	CCI sq. cg.	500
75	Gen. Elec.	I sq. cg.	750
50	Allis Ch.	ANY sl. rg.	1500

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec. 1	MPC	125/170	1150
100	Fair Morse	TR	250	800
75	Whse.	S	125	600
60	Gen. Elec.	DLC	250	450
50	Cr Wheeler	CC	125	1800
50	Cr. Wheeler	CCD	250	850
36	Lincoln b.b. 600 amp.		50	1200
25	Whse.	S	125	1200
25	Gen. Elec.	DLC	125	900
25	Gen. Elec.	RC	250	900
25	Whse. b.b.	SK113	250	1800
25	Cr. Wheeler b.b.	CCD-DH	125	1800
20	Allis Ch. (2)		125	475

SPECIAL — 3 — Oil Gear Co. Pumps, 1100 lbs. 104 gpm., on steel base — BARGAIN.

60 CYCLE A.C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
300	Whse.	ped.	240, 480	900
200	Gen. Elec.	ATB	2300	600
165	Elec. Machy.	BRKT	240/480	900
150	Allis Ch. 25 cycle		240/480	500
125	Allis Ch.	B	240/480	900
100	Cr. Wheeler		240/480	600
94	Continental b.b.	8585	240/480	1200
75	Gen. Elec.	ATB	240, 480	1200
31	Whse. (4)	b.b.	120, 208	1200
10	Whse. (5) NEW	b.b.	240	1200

ARTHUR WAGNER COMPANY

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ELECTRICAL EQUIPMENT—REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

SLIP RING MOTORS

3 Phase—60 Cycle

QN.	H.P.	Speed	Make	Type
5	52	550	G.E.	IQC-5013*
1	60	1200	G.E.	MT-B-343
1	60	570	G.E.	MTC-5546
1	75	720	G.E.	MT-556
1	75	1750	West.	CI-653C
1	80	575	G.E.	MTC-5352
1	100	1760	Al.-Ch.	ARY-223BS
2	125	430	G.E.	IL-16
1	150	385	G.E.	IM-17
1	150	490	West.	CW-956A
2	200	600	G.E.	IM-17
3 (new)	250**	296	West.	CW-20-53-15
2	300	514	G.E.	IM-17A
1	400	505	West.	CW

*2 phase. 50 cycle.

SQUIRREL CAGE MOTORS

3 Phase—60 Cycle

QN.	H.P.	Speed	Make	Type
1	25	1140	West.	CCL
1	30	870	West.	CS-646
2	30	1150	G.E.	KT-326
1	50	900	G.E.	KT-346
1	50	850	West.	CCL
2	50	514	Howell	TEFC
1	75	1750	West.	CS-761#
1	100	495	Al.-Ch.	AN
1	100	580	G.E.	IK-15
2	100	500	West.	CS
1	150	580	West.	CCL
5	150	1800	Howell	K-684
5	200	580	G.E.	KT-5668
1 (New)	200*	2950	West.	CS-8120-TEFC

*50 cycle. 500 volts. #2200 volts.

ADJUSTABLE SPEED D.C. MOTORS
6—40/50 HP, 400/1600 RPM, 230 volt, Cont., Shunt Wound, Reliance and Allis-Chalmers, Ball Bearing, Adjustable Speed D.C. Motors Complete with Non-reversing Dynamic Braking Controllers.

NEW D.C. MOTORS
25—Allis-Chalmers, 10 HP, 1200 R.P.M., 230 Volt, D.C., EB-80, Drippproof, 40°, B.B.
20—West., 2.5 HP, 600 RPM, 230 volt, DC Marine SK-93, Tot. Encl. B.B., ½ Hr. 55°.

4-VARIABLE VOLTAGE DRIVES
4—40 HP, General Electric Variable Voltage Ward Leonard Drives, each consisting of:
1—40 KW, 250 Volt, Induction M-G Set, with two auxiliary 5 KW generators with exciters.
1—40 HP, 250/1500 RPM, Type CD-1441 DC Motor.
2—Auxiliary, 5 HP, 1750 RPM Type B-284 DC Motors.
1—Enclosed magnetic control providing jog forward, jog reverse, run, fast, slow, and stop. Complete with motor operated field rheostat

The Above Listings Are Representative of Items Available for Prompt Shipment from Our Cleveland Warehouse. We Also Have a Large Stock of Synchronous Motors, Constant and Adjustable Speed DC Motors, Rotary Converters, Circuit Breakers and Control Equipment.

ELECTRIC GENERATOR & MOTOR CO.

4521 HAMILTON AVE. — CLEVELAND 14, OHIO

BOILER TURBINES

2—400 H.P. Erie City, type-E, stokers, OHIO, PENN'A & ASME stamping.

2—400 H.P. Springfield, oil burners, N. J. & ASME stamping.

2—25,000#, per hour, 425#, 650 T.T. boiler & turbine complete plant (1) 1500 KW. bleeder, (1) 1500 K.W. back pressure turbo's, National Board boilers.

1—625 & 1—1000 K.W. turbine units complete with switch boards, seen operating, immediate delivery.

H. P. BREARLEY

3423-91st Street
Jackson Heights, N. Y.

DIESEL MARINE ENGINES

Pair—2000 HP NELSECO Direct Reversing, 10 Cylinder, 4 Cycle, Bore 20⅞" x 20⅞" Stroke. Port and Starboard.

Pair—1200 HP NELSECO Direct Reversing, 6 Cylinder, 4 Cycle, 325 RPM, 20⅞ x 20⅞. Port and Starboard engines.

Suitable for Steam Conversion

Immediate Delivery

ALJON ELECTRIC DIESEL CO.

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Sterling 3-6515

NEW GENERATORS

Leland, 2.5 KVA, 120-volt, 1800 RPM, 60-cycle, single phase, self excited AC Generators, 1 bearing.

Clark Elec. 7½ KW, 120-volt, 1800 RPM, single phase, 1 bearing AC Generator complete with voltage regulator.

Clark Elec. 15 KW, 120-volt, 1800 RPM, 60-cycle, 1 phase, 1 bearing AC Generators complete with voltage regulators.

* * * * *

3 KW gasoline engine driven generator units.

Carson Machine & Supply Company
Oklahoma City Oklahoma

TURBO GENERATORS

1—1250 KW General Electric Turbo-Generator, Type ATB, Form HT, 3800 RPM, direct-connected exciter, Wheeler Jet Condenser.

1—2000 KW General Electric Turbo-Generator, 180 lb. pressure, 3600 RPM Generator, Type ATB, 600 Volt AC, 2403 Amp. with Westinghouse-LeBlanc Jet Condenser.

1—1500 KW Westinghouse Turbo Generator with Surface Condenser 4200 sq. ft.

Republic Textile Equipment Co.
40 Worth Street, New York 13, N. Y.
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Large Quantities of:
PANEL WIRE & TERMINAL LUGS; PANEL FITTINGS & HARDWARE; INSTRUMENTS
— ALL NEW —

INDUSTRIAL TRADING COMPANY
30 Church St., New York 7, N. Y.

DIESEL ENGINE SETS FOR SALE

1—300 KW. 240 v. 257 RPM. F.M.
2—200 KW. 220 v. 900 RPM. NEW
1—200 KW. 240/480, 514 RPM. Buckeye
1—175 KW. 240 v. 514 RPM. Atlas
1—150 KW. 240/480 v. 900 RPM. Caterpil.
1—100 KW. 480 v. 327 RPM. F.M.

STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave. New York 33, N. Y.

7—Westinghouse Flex-Arc Welders, 400 Amps. 40 Volts, Motors: 3 220 Volts, 60 Cyc.

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ELECTRIC APPARATUS REPAIR CO.
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3 YD. DRAGLINE BUCKET

Page Class RM Special 72" wide
Excellent condition!
IRON & STEEL PRODUCTS, INC.
13488 S. Brainard Ave., Chicago 33, Illinois
"ANYTHING containing IRON or STEEL"

MOTOR-GENERATOR SETS

250 VOLT

KW.	Make	Speed	Drive
500	GE	720	60 cy. syn.
400	GE	600	60 cy. syn.
400	GE	1200	60 cy' syn.
300	West	720	60 cy. syn.
200	GE	1200	60 cy. syn.
150	West	850	60 cy. sq. cg.
150	Al.-Ch.	500	25 cy. rot.
125	Hertner	1200	60 cy. syn.
100	GE	1200	3 wire 60 cy.
100	GE	750	25 cy. rot.
75	GE	1200	60 cy. syn.
50	West	1200	60 cy. sq. cg.
40	GE	1800	60 cy. cyn.
25	GE	1800	60 cy. sq. cg.
15	GE	1200	60 cy. sq. cg.
15	GE	750	25 cy. sq. cg.
10	West	900	60 cy. sq. cg.
5	Rel.	1800	New VS
3	Rel.	1800	New VS

125 VOLT

KW.	Make	Speed	Drive
200	GE	750	25 cy. syn.
150	West	1200	60 cy. syn.
125		900	60 cy. slip
100	West	1200	60 cy. syn.
75	GE	1200	60 cy. sq.
75	GE	1200	60 cy. sq.
50	Sprague	900	60 cy. sq.
50	GE	750	25 cy. sq.
50	West	750	25 cy: sq.
35	West	750	25 cy. sq.
35	Sprague	750	25 cy. sq.
25	West	1800	60 cy. sq.
20	West		60 cy. sq.
12	GE	1800	60 cy. 3 wire
10	GE	1800	60 cy. 3 wire
5	Reliance	1800	new

Low Voltage and 125 V and 600 V Sets also in Stock

"All equipment rebuilt in our shops and guaranteed on same basis as new equipment."

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MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 phase 25 cycle, 220/440 Volts

H.P.	Make	Type	Frame	RPM
5	West.	CS		750
5	West.	CS		750
5	West.	CS		750
5	West.	CS	453	750
5	West.	CS	453	750
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
5	G.E.	KT	948	1430
10	G.E.	KT	312	750
10	Wagner	19TBM		750
10	Wagner	19TBM		750
10	Wagner	19TBM		750
15	G.E.	I Form K		750
15	West.	CS	4052	750
15	West.	CS	573	750
15	West.	CS	573	750
15	West.	CS	573	750
15	G.E.	KT	303	1500
20	West.	CS		750
20	West.	CS	645	715
20	West.	CS	645	715
20	West.	CS	405	675
20	West.	CS	405	675
25	West.	CS		750
25	West.	CS		715
40	G.E.	I Form K		750
40	G.E. (S. R.)	MT	347	750
40	G.E. (S. R.)	MT	347	750
50	G.E. (S. R.)	MTC	5537	750
75	G.E. (b.b.)	KT	557	750
75	G.E.	KT	559	500
75	G.E.	I Form K		500
75	G.E.	I Form K		500
75	G.E.	I Form K		500
75	G.E. (2200 v.)	I Form K		750
100	G.E.	I Form K		750
100	West.	CS		750
100	West. (2200 v.)	CS	871C	750
100	West. (2200 v.)	CS	871.52C	1460
100	West. (2200 v.)	CS	871.52C	1460
125	West. (S. R.)	CW		480
150	G.E.	I Form K		355
150	Crocker Wh.	75R		725
150	G.E. (2200 v.)	I Form K		750
150	G.E. (2200 v.)	I Form K		750
150	Allis Ch.	Slip Ring		720
150	G.E. (2200 v.)	KT b.b.	557Y	1470
200	West. (2200 v.)	CS	1013	480
200	G.E. (2200 v.)	I Form K		485
200	G.E. (S. R.)	I Form M		480
200	G.E. (S. R.)	I Form M		480
200	West. (S. R.)	CW	1011	480
200 /400	G.E. 2 Sp.	K	569B8	740/1485
225	Elec. Mach. (2200 v.)	Synchronous		500
300	West. (S. R.)	CW		500
500	G.E. (2200 v.)	KT		487
500	G.E. (550 v.)	I Form K		500

MOTORS
25 Cycle—3 Phase—550 Volt

				RPM
7—	25 HP	West.	Type CS	3/25/550/750
1—	30 HP	West.	Type CS	3/25/550/750
1—	60 HP	West.	Type CS	3/25/550/750
1—	65 HP	West.	Type CS	3/25/550/500
1—100 HP		West.	Type CS	3/25/550/750

TRANSFORMERS
3—150 KVA West., OISC—25/1/2300/460.
3—200 KVA West., OISC—25/1/2300/460.
3—500 KVA Pitts., OISC—25/1/2300/230/460.
1—2500 KVA Gen. Elec. 60/3/20000/2000 V.

3 phase, 60 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	Westinghouse	CS	1200	1883285
15	Westinghouse	MS	1200	9445931
20	Westinghouse	CS	1200	2160500
20	Westinghouse	MS	1200	1059826
20	Westinghouse	CS	1800	1863526
20	Westinghouse	CS	1800	2695044
25	Westinghouse	MS	1200	1562926
25	Westinghouse	MS	1800	1334763
25	Westinghouse	CS	1200	2286768
25	Westinghouse	MS	1200	1197673
25	Wagner	BP	1200	124906
30	Westinghouse	MS	1200	1197674
30	Fairbanks-Morse	V-H-10D	1800	43476
40	Westinghouse	CS	900	1896969
40	General Electric	I-K	1800	73318
40	Westinghouse	MS	1200	1506806
40	General Electric	I-K	1200	181444
40	Westinghouse	MS	1200	1027421
50	Westinghouse	MS	1800	1289389
50	Westinghouse	MS	1200	854410
50	Westinghouse	CS	1800	2691183
50	General Electric	14	1800	181444
50	General Electric	KT-852	720	
50	Allis Chalmers		1800	3K28825
60	Reliance		1200	B11458
60	General Electric	I	1800	292596
60	Westinghouse	CCL	1800	329654
60	Robbins-Myers	K	1800	P515362
60	Triumph		1800	C14248
60	Westinghouse	CCL	1200	854121 (2200 v.)
100	Westinghouse	CCL	1800	1043213
100	Westinghouse	CCL	1800	765231 (2200 v.)
125	Westinghouse	CS	1200	2318625

HP	Make	Type	RPM	Serial No.
150	Westinghouse	CS	1800	2429726
150	Westinghouse	CCL	900	433385
150	Westinghouse	CS	1200	4572896 (2300 v.)
150	General Electric	I-K	1200	
150	Westinghouse	CCL	720	302349 (2200 v.)
200	General Electric	I-K	900	239917 (2200 v.)
200	Westinghouse	CCL	900	919537 (2200 v.)
250	General Electric	I-K	600	2248234
300	General Electric	I-K	720	2357743
400	General Electric	I-K	900	2347845

SLIP RING MOTORS
3 phase, 60 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
20	Westinghouse	CW644C	875	1969982
20	General Electric	MT332	844	1580010
30	Westinghouse	HF	1745	1868408
40	Westinghouse	CW748	690	1496823
250	Allis Chalmers	3 bearing	595	104880 (2300 v.)
400	General Electric	I-M	900	224674
400	General Electric	I-M	900	245782

MAGNETIC CONTACTOR
1—300 H.P. Cutler Hammer, Across the Line Contactor. 3 Phase, 25 Cycle, 440 Volts

25 CYCLE GEARHEAD MOTORS
1—10 HP. Westinghouse Frame. 584. Enclosed 1500/378 RPM.
15 HP. Master Frame 405 Enclosed 1430/414 RPM.

SPECIAL DC MOTORS
1—40 H.P. Reliance Ball Bearing Drip Proof Type T-385-T 230 V D.C. 400/1500 RPM.
1—125 H.P. Gen. Elect. 230 V. D.C. Motor. 1750 RPM.
1—40 HP Reliance Variable Speed 300 v. DC. Dripproof Ball Bearing 400/1500 RPM.
1—45 HP. G.E.

MOTOR GENERATOR SET
300 KW Westinghouse Synchronous. Generator Type SK 201, 250 V. D.C. 800 Amps. 900 RPM Motor. 290 HP. Synchronous. 3 Phase 60 Cycle 900 RPM. Can be wound for 440 V. or 2200 V. Complete with panels, exciter, and starting equipment.

CAPACITORS
8—30 KVA Gen. Elect. Pyranol Filled Capacitors 3/60/2300 v.
8—60 KVA Gen. Elect. Pyranol Filled Capacitors 3/60/2300 v.

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

POWERHOUSE EQUIPMENT

A. C. MOTORS

Manufacturer	Type	H.P.	Speed	Current
Gen. Elec.	Squirrel cg.	650	300	2200/3/60
Gen. Elec.	Squirrel cg.	375	720	2200/3/60
Gen. Elec.	Squirrel cg.	350	875	6300/3/60
Gen. Elec.	Squirrel cg.	200	600	2200/3/60
Gen. Elec.	Slip ring	150	600	550/3/60
West.	Slip ring	100	580	550/3/60
Fairbanks	Slip ring	100	575	550/3/60
Gen. Elec.	Synchron.	436	720	13200/3/60
Gen. Elec.	Synchron.	436	720	13200/3/60
Gen. Elec.	Synchron.	225	900	2200/3/60
Gen. Elec.	Synchron.	187	900	2300/3/60

CRANES
1 only: Bridge crane — 50' span — 20 ton lift. Fully electrified for 440/3/60 current. Complete with cab and controls.
1 only: Bridge crane — 40' span — 20 ton lift. Fully electrified for 440/3/60 current. Complete with cab and controls.

HOISTS
2 only: Northern-Hi-lift monorail hoists. 3 ton lift @ 20 fpm. fully electrified for lift and travel for 220 or 440/3/60 current. Complete with cab and controls.

AIR COMPRESSORS

Mfgr.	Delivery	Speed
Bury	800 cfm	150 rpm
Ingersol Rand	450 cfm	185 rpm
Ingersol Rand	265 cfm	330 rpm
Sullivan	218 cfm	900 rpm
Ingersol Rand	2020 cfm	300 rpm
Lardlaw	3000 cfm	300 rpm

PUMPS CENTRIFUGAL

Size	No. on Hand	Capacity	Head
20"	1	10000 gpm	95'
12"	1	1500 gpm	200'
6"	1	1200 gpm	48'
6"	2	1200 gpm	48'
6"	1	1000 gpm	70'

PUMPS MISCELLANEOUS
1 only: Deep well pump — Fairbanks Morse. 18"

ENGINES DIESEL

Manufacturer	Output	Speed
Crossley	165 N.P.	350 rpm
Vivian	120 H.P.	600 rpm

ENGINES STEAM

Manufacturer	Output H.P.	Speed
Bellis Morcom	600	350

TURBINES STEAM
1 only: Terry turbine — 200 H.P. @ 1500 rpm

TURBINES-HYDRAULIC

Manufacturer	Type	Characteristics	
Pumps & Powers	Pelton	275 HP	600 rpm
Pelton:	Pelton	200 HP	720 rpm
Pumps & Powers	Pelton	200 HP	900 rpm
Pelton:	Pelton	175 HP	720 rpm
Pumps & Powers	Pelton	150 HP	900 rpm

GENERATING UNITS A.C.
1 only: General Electric Steam Turbine Generator Set.— Condensing 3000 KW — 2300 — 180 p.s.i.
1 only: Westinghouse Steam Turbine Generator Set — Condensing 1000 KW — 2200 — 125 p.s.i.
1 only: B&W-Westinghouse Steam Engine Generator Set — 62.5 KVA — 550 or 440
1 only: Westinghouse Steam Turbine Generator Set — 62.5 KVA — 240 — 150 p.s.i.

GENERATING SETS D. C.
1 only: Goldie McCulloch Steam Engine Generator Set — 75 KW — 125 Volts — 150 p.s.i.
1 only: Allen Steam Engine Generator Set — 26½ KW — 105 Volts — 150 p.s.i.
1 only: Allis Chalmers Steam Engine Generator Set — 100 KW — 230 Volts — 150 p.s.i.
1 only: Goldie McCulloch Steam Turbine Generator Set — 200 KW — 110/220 Volts — 150 p.s.i.

GENERATORS D. C.

Manufacturer	No. on Hand	Rating	Speed	Volts
Crocker Wheeler	1	400 KW	350	575
G.E.	1	250 KW	720	550

ALL ITEMS IN STOCK FOR IMMEDIATE DELIVERY. WRITE, WIRE OR PHONE YOUR ENQUIRIES ON GENERAL POWER HOUSE EQUIPMENT. WRITE FOR OUR COMPLETE LISTING.

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GRANVILLE ISLAND, VANCOUVER, B.C. Tel. PAcific 3487

A COMPLETE SERVICE

CHICAGO ELECTRIC

Guaranteed Rebuilt Power Equipment

ENGINE SETS, GAS & DIESEL

KVA	Current	Speed	Type
75	3/60/220/440	600	Diesel
62½	3/60/127/220	1200	Diesel
30	3/60/127/220	1200	Diesel
31¼	3/60/208/120	1200	Gas
31¼	3/60/208/120	1200	Gas
15	110 DC	1000	Gas
7½	1/60/115	1800	Gas
5	32 DC	7257	Gas
5	110 DC	1150	Gas
1	60/110 AC	1800	Gas

A quantity of 250 and 300 watt gas sets.

D. C. GENERATORS

Qua.	KW	Volts	Make	Speed
25	20	125	Bogue	1200
65	.4	12	Champion	1200
50	1½	230	Star	1750
1	40	125	G.E.	1200
8	25	120	Cr. Wheeler	1200
1	100	115	Burke	700
1	125	250	Milw.	575
3	150	275	Westg.	1200
2	300	250	G.E.	1200

AIR COOLED TRANSFORMERS, guaranteed delivery 16 weeks, from 1/4 to 20 KVA, any volts.

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Phone CANAL 2900

REBUILT POWER EQUIPMENT

READY TO SHIP!

SLIPRING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
½	Howell	220	1080	
2.25	Northwestern	440	1080	HEW 1½
15	Triumph	220	1150	
75	Fairbanks-Morse	220	600	BV
100	Fairbanks-Morse	220	1200	BV
100	CR. WH.	200	700	
100	Burke	220/440	600	EMV-20
200	G.E.	220/4440	1200	M-1
235	Westg.	440	450	CW
400	Westg.	2200	435	CW

ALTERNATING CURRENT MOTORS
3 ph., 60 cy.

H.P.	Make	Volts	R.P.M.	Type
10	Westg.	220/440	1750	CS
25	Al. Ch.	220	685	
75	G.E.	220/440	514	I
90	G.E.	220/440	600	I
100	Fynn Weichel	220/440	900	31V-RN
100	Westg.	220/440	1200	
125	G.E.	220/440	720	Vertical

COMPRESSORS

2—315 cu. ft. 100# pres. Ingersoll Rand Models 315 and 315A Portable Air Compressors with 105 HP. Waukesha Oil Engines complete with accessories.

1—610 cu. ft. 100# pressure Gurry Horiz. Compressor.

VARIABLE SPEED MOTORS
230 VOLT D. C.

		M.	Type
15	Reliance	500/1800	
15	Westg.	875/1600	SA
10/15	Electro Dy.	600/1200	
10	Westg.	800/1600	SA
10	Cr. Wh.	690/895	CMC
10	J. C. Curran	950/1230	
10	G.E.	625/1250	LC
10	Westg.	400/1600	SA
7½	Westg.	650/1300	
4	G.E.	850/1700	LC-8
3	G.E.	400/1200	RLC-114
3	Roth	500/1000	RS

SERIES WOUND MOTORS

H.P.	Make	Volts	R.P.M.	Type
35	Westg.	230	550	49D
32	Shaw	230	485	5L2E
28	Westg.	220	385	904
25	Westg.	230	600	MT
15	Westg.	220	650	RL
15	Cr. Wh.	220	270	SM
10	Westg.	230	750	MT-00
7½	Westg.	230	975	S
3½	Westg.	230	1200	L

230 VOLT DC MOTORS

H.P.	Make	R.P.M.	Type
25	G.E.	650	MD
25	Westg.	825	SK113
20	Westg.	600	M
20	Westg.	975	S-6

D. C. CLARK CONTROLLER

1—250 HP Clark Vari Time magneto controller 230 v. DC reversing, used for plugging service. Can also be used for non-reversing.

MOTOR GENERATOR SETS—
250 & 500 V. D. C.

1—150 KW, 250/275 v. DC 900 rpm. 546 amps. compound wound Ridgeway Generators, direct connected to 1—225 HP 2200 v. 900 rpm. 3 ph. 60 cy. Ridgeway Synchronous Motor.

1—75 KW. 250 v. DC Westg. type SK Generator direct connected to 220 or 440 v. 3 ph. 60 cy. Induction Motor.

1—30 KW 250 v. DC generator direct driven by 46.5 HP 1750 rpm. 220/440 v. 3/60 Westg. Motor.

2—20 KW 1700 rpm. 250 v. Westg. SK gens. dir. driven by 30 HP 220 or 440 v. 3/60 cy. motors.

1—3 KW 1350 rpm. 250 v. type S Westg. Gen. dir. conn. by coupling to 5 HP 1350 rpm. 110 v. Westg. Mtr.

INDUSTRIAL TRUCKS

5—Automatic type LO-5 Low Lift Trucks capacity 5 ton, platform type. Equipped with towing coupler and bumper for pushing cars.

7—New 4 ton Yale & Towne model Y8W Multi-Stroke Hand Lift Platform Trucks.

PUMPS

1—135 gpm. 53 ft. head Allis Chalmers Pump
1—150 gpm. 130 ft. head Dayton Dowd Pump
1—200 gpm. 60 ft. head Dayton Dowd Pump
1—244 kpm. 60 ft. head Dayton Dowd Pump
2—350 gpm. 35 ft. head Allis Chalmers Pumps
1—400 gpm. 85 ft. head Allis Chalmers Pump
1—500 gpm. 115 ft. head Dayton Dowd Pump
1—525 gpm. 100 ft. head Dayton Dowd Pump
1—600 gpm. 105 ft. head Dayton Dowd Pump
1—750 gpm. 20 ft. head Dayton Dowd Pump
1—750 gpm. 70 ft. head Dayton Dowd Pump
1—2000 gpm. 170 ft. head De Laval Pump
1—3500 gpm. 130 ft. head De Laval Pump
1—4000 gpm. 90 ft. head De Laval Pump
1—5600 gpm. 143 ft. head Alberger Pump
1—8000 gpm. 120 ft. head Ingersoll Rand Cameron Pump.

WRITE, WIRE OR PHONE YOUR ELECTRICAL NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

MOTORS—M. G. SETS—CONTROL

In Stock—Immediate Shipment—Rebuilt & Guaranteed

230-VDC. CRANE & MILL MOTORS

H.P.	Make	Type	R.P.M.
(1) 2½	G.E.	C.O.-1803 (C.P.)	650
(1) 3	G.E.	C.O.-1803	700
(1) 5	G.E.	MD-101	800
(1) 6	G.E.	C.O.-1805	1150
(1) 7½	G.E.	C.O.-1804	725
(1) 9	G.E.	MD-102 (Back Axle C.P.)	975
(1) 10	G.E.	C.O.-1805	925
(1) 10	G.E.	C.O.-2504	700
(5) 14/19	C.W.	BW (Back Axle)	675/560
(4) 14/19	C.W.	BW	675/560
(1) 15	G.E.	C.O.-1806	875
(1) 17	G.E.	MD-103	700
(1) 21	G.E.	Type-52	345
(1) 20	Westghse	HK-6	650
(1) 25	G.E.	C.O.M.-1828 (C.P.)	850
(2) 35	G.E.	C.O.-2506	650
(1) 30/45	C.W.	DW	620/520
(1) 30/45	G.E.	MD-104½ (C.P.)	625/500
(1) 52	Westghse	K-10	740
(1) 54/80	C.W.	FW	575/480
(2) 50	G.E.	MD-105 (C.P.)	475
(1) 65	G.E.	C.O.-1811 (C.P.)	800
(1) 60	Westghse	MTA-No. 2 (Back Axle)	

(All above series wound except where C.P. Compound Wound)

230-VDC. (VARIABLE SPEED)

H.P.	Make	Type		R.P.M.
(1) 3/4	G.E.	B.D.-225	(SH)	600/1800
(1) 3	G.E.	RLC-111	(SH)	500/1500
(1) 3	G.E.	CR-3		500/1500
(1) 3 (D.P.B.B.)	Reliance	14-T	(SH)	1200/3600
(1) 5	G.E.	RLC-115	(SH)	250/1000
(1) 5	G.E.	RF-9	(SH)	450/1350
(1) 5	Westghse	SK-35	(SH)	1150/1650
(1) 6	G.E.	RF-9	(SH)	450/1350
(1) 7½	G.E.	RF-10A	(SH)	450/1350
(1) 7½	Westghse	SK-70	(C.P.)	450/1800
(1) 7½	Westghse	SK-70		600/1800
(1) 7½	Westghse	SK-60-L	(C.P.)	650/1300
(1) 8	Westghse	SK-100-L	(SH)	300/1200
(1) 8½	G.E.	RF-9		600/1800
(1) 10 (115-v.)	Elec. Dy.	7½-S		250/1000
(3) 10	Westghse	SK	(C.P.)	400/1600
(1) 10	G.E.	RF-12	(SH)	300/1200
(1) 10/15	Al. Ch.	EB-100	(SH)	575/1725
(1) 15	G.E.	RF-11	(SH)	400/1600
(1) 15	G.E.	RF-10	(SH)	550/1650
(1) 19	Westghse	SK-100-L	(C.P.)	600/1200
(1) 20	Triumph	Comp.		250/1000
(1) 20	G.E.	RLC-702	(SH)	250/1000
(2) 20	G.E.	RF-12	(SH)	400/1600
(1) 25	G.E.	CD-1258-Y	(SH)	200/ 800
(1) 25	Reliance	262-T	(C.P.)	500/1500
(1) 25	G.E.	RF-13	(SH)	250/1000
(1) 25	G.E.	RF-13	(SH)	400/1200
(1) 30	Westghse	SK	(C.P.)	400/1600
(1) 35	Westghse	SK-160	(C.P.)	500/ 750
(1) 35	G.E.	RF	(SH)	250/1000
(1) 40	G.E.	CD-1238	(SH)	400/1200
(1) 50	Westghse	SK	(SH)	250/1000
(4) 100	Reliance	1050-T	(SH)	400/1200

SLIP RING (CONSTANT DUTY) 220/440-V., 3-PH., 60 CY.

H.P.	Make	Type	R.P.M.
(1) 3	G.E.	M.Q.-1801 (2-PH)	1080
(2) 7½	G.E.	M.T.-201 (550-V)	1200
(1) 10	G.E.	I.Q.- (2-PH)	1120
(1) 38	G.E.	I-M	1200
(1) 200	C.W.	(2200-V)	590
(1) 250	Westghse	C.W.	435
(1) 400	G.E.	M.T.-412	600
(1) 500	Al. Ch.	A.N.	585
(1) 500	Westghse	C.W. (2200-V)	360

1—150 HP., Electro Dynamic Variable Speed, 3-bearing, Frame 75-S, Comp. Interpole, 250/500 RPM., 2 hrs. 185 HP., with Monitor Control Panels, built in Resistance, Auto 4-step acceleration, non-reversing, P.B. control.

CONSTANT SPEED 230-VDC. MOTORS

H.P.	Make	Type	R.P.M.
(2) 2	Al.-Ch.	E-50	1750 SH.
(1) 3	Reliance	T-224	3500 SH.
(1) 3	G.E.	CD-55	1150 SH.
(1) 5	Westghse	SK-33	1150 SH.
(2) 5	Westghse	SK-40	850 SH.
(1) 5	G.E.	RC-27A	1150 SH.
(1) 5 (new)	Al.-Ch.	EB-65	1750 SH.
(2) 7½	Westghse	SK-60	950 C.P.
(5) 7½	Westghse	SK-43	1150 SH.
(1) 7½	Westghse	SK-5L	550 C.P.
(1) 7½	Westghse	SK-40 (115-V.)	1150 SH.
(1) 10 (new)	Al.-Ch.	EB-80	1150 SH.
(1) 10	Westghse	SK-50L	1300 SH.
(1) 15	Al.-Ch.	Shunt	800
(1) 15	Westghse	SK-100L	850 SH.
(1) 15	C.W.	CCM	800 C.P.
(2) 20 (new)	Elec. Dy.	182N (Enc.) (B.B.)	1500 C.P.
(1) 25	Westghse	SK-100L	1100 SH.
(1) 30	G.E.	DCL-201	1100 SH.
(1) 35	Westghse	SK-130	850 SH.
(1) 50	Westghse	SK	1700 SH.
(2) 75	Reliance	T	875/1200 C.P.

SLIP RING MOTORS (CRANE TYPE) 220/440-V., 3-PH., 60-CY.

H.P.	Make	Type	R.P.M.
(2) 2	G.E.	MTC-5140	1200
(1) 2	G.E.	MTC-5932	1130
(1) 3	G.E.	MTC-5180	900
(1) 5	G.E.	MTC-5180	1200
(4) 10	G.E.	MTC-5952	1165
(1) 11	L. Allis	S.H.	1200
(1) 22	G.E.	ITC-5011	
(2) 35	G.E.	MTC-5336-Y (Enclsd)	550
(1) 35	Westghse	C.I.	720
(1) 37	G.E.	ITC-5011	1200
(1) 40	Westghse	C.I.-746-A	575
(1) 50	Westghse	C.I.-6440	870
(1) 52	G.E.	ITC-5013	600
(1) 52	G.E.	ITC-5012	900
(1) 200	Westghse	M.W.	580

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TARENTUM PRODUCTS CORPORATION

TARENTUM, PENNSYLVANIA

Offers for sale the following equipment now in use:

1—Westinghouse DC Motor 75 HP 230 V 285 Amp 575 RPM Frame 183 Serial #4778560. Complete with starting control, circuit breaker and meter.

1—Elliott Water Pump, capacity 500 gallons per minute. Serial #37075 Direct connected to one G. E. Motor 25 HP DC Type CD 85-230 91.3 amps 1750 RPM Ser. #1530365. Complete with one starting control and switch.

1—Westinghouse Generator 70 KW 250 V DC 280 amp. 375 RPM Ser. #345451, with one Field Rheostat, one two-pole circuit breaker 600 amp., one Westinghouse 500 amp. ameter and shunt. This Generator driven by Buckeye Steam Engine, 100 lbs. steam pressure engine #5156.

1—2000 K.W. 2300 Volts, 3 phase, 60 cycle Turbine Generator complete with all accessories. Rigid frame type.

1—Allis-Chalmers Induction Motor 250 HP 870 RPM 2200 V 3 ph 60 cy 59 amp Serial #2K13566.1.

1—G.E. Induction Motor type KT 328-6-1200 Form B 3 ph 60 cy 220 v 25 HP 61 amp. 1200 RPM Ser. #1053934 complete with one G.E. Oil Switch Type F Form K20 80 amp 600 V Ser. #368400.

1—G. E. Starting Compensator CR 1034 220 V3 ph 60 cy Type NR 1622.

1—G. E. Induction Motor (slipring) Frame 15A 150 HP Form M 720 RPM 2200 3 ph 60 cy 36 amp. Ser. #1180132.

1—G. E. Induction Motor (slipring) Frame 15A 150 HP Form M 720 RPM 2200 V 3 ph 60 cy 36 amp.

1—Westinghouse 30 HP D.C. Motor 220 V 117 amp. 975 RPM Ser. #233501.

1—G. E. Motor DC Type MP Form H 20 HP 1025 RPM 220 V 70 amp. Ser. #19880, complete with manual starting equipment.

1—G. E. Motor DC Type RC30 Form A 15 HP 850 RPM 230 V 53-5 amp. Ser. #957750, complete with variable speed control for armature and field.

1—G. E. Motor DC 7.5 HP 230 V 30.2 amp 850 RPM Type RC-29A Form A29 Ser. #1145541.

1—G. E. Motor DC 10 HP 230 V 375.1 amp 850 RPM Type RC 29 Form A 29 Ser. #1148660.

1—Westinghouse DC Motor type S 5 HP 220 V 21 amp 1300 RPM Ser. #112692.

1—G. E. Motor DC 35 HP 129 amp 230 V 700 RPM DLC 202 Form A Compound Ser. #434542, complete with starting control.

1—G. E. Induction Motor (slipring) Type IE 13AA-4-150-1800 Form M 3 ph 60 cy 2200 V 150 HP 34.5 amp 1745 RPM Ser. #3884576 complete with panel. One G. E. Switch Panel Type ATI 59008, one Drum Controller and Resistance, variable speed.

1—Master Electric Worthington Pump and Motor. Pump is good for 100 gal. per minute 5 HP motor 230 V DC 3425 RPM Ser. #CC-3495.

1—Robbins & Myers Hoist ½ HP 230 V DC 400 RPM Ser. M71309KH.

1—Master Electric Gear Head Motor 1 HP 230 V DC 1725 RPM Ser. CE963.

1—Shepard Littabout Electric Hoist 2,000 lb. capacity 230 V DC Ser. #11339.

1—Wright Electric Hoist 1,000 lb. capacity 230 V DC 1200 RPM Ser. #27668.

3—ILG Ventilating Fans ¼ HP 230 V DC 855 RPM.

2—G. E. CP 27 Compressor Head Air Pumps 230 V DC Complete with pressure line switches.

1—Allis-Chalmers DC Motor 5 HP 220 V 1050 RPM Ser. 44037.

1—Westinghouse DC Motor 10 HP 46 amp 230 V 1725 RPM Frame 60L Ser. 143633.

1—G. E. Motor DC Type C-27 B Form A112 10 HP 37.5 amp 230 V 1750 RPM Ser. #1454993, complete with control.

1—R40 Reducer, 12 to 1 ratio.

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DEPENDABLE GUARANTEED ELECTRICAL EQUIPMENT

SQUIRREL CAGE MOTORS

H.P.	R.P.M.	Volts	Make	Type
150	600	440	W. Elec.	
150	1200	2200	G.E.	KT(vert)S.S.
125	1200	2200	A.C.	
125	1800	220	A.C.	
75 (2)	1800	2200	G.E.	KT(vert.)s.s.
30	1800	2200	G.E.	KT(vert.)s.s.
30	1800	220	F.M.	UJL(vert.)s.s.
20	1200	220	G.E.	KT(vert.)s.s.
15 (5)	1200	220	F.M.	UHA(vert.)s.s.
15	1800	220	G.E.	KT(vert.)s.s.
7½	3600	220	F.M.	UJL(vert.)h.s.
5 (2)	3600	220	West.	CCL(vert.)s.s.
5	1200	220	Ideal	A(vert)s.s.

SLIP RING MOTORS

H.P.	R.P M.	Volts	Make	Type
75	600	440	West.	CI
16/50	250/850	220	West.	
40	900	2200	A.C.	
35	900	550	A.C.	(vert.)s.s.
30	900	2300	F.M.	B.V.
30	900	220	G.E.	MT
30	1200	440	West.	CW
30	1800	440	A.C.	ARY
20	900	220	West.	HF
20	1200	2200	G.E.	I
11	900	440	G.E.	ITC

SYNCHRONOUS MOTORS

H.P.	R.P.M.	Volts	Make	Type
300	150	4000/2300	G.E.	T.S.
40	1200	4160/2300	E.M.	

D.C. MOTORS

H.P.	R.P.M.	Volts	Make	Type
25	750	230	G.E.	DLC
25 (2)	650	230	G.E.	DLC
15 (2)	700	230	G.E.	CVC
15	1300	500	G.E.	CE

Also 10—7½—5 and smaller 230 volts.

A.C. GENERATORS

3 Phase 60 Cycle

KVA	R.P.M.	Volts	Make
250	240	480	F.M. (engine type)
225	150	4000/2300	G.E. (engine type)
112½	900	600	G.E. Type ATB
75	1200	240	West. (belt exc.)
25	1200	250	G.E. (360 cy.)
6½(2)	1800	120/240	Mast. (1 ph. eng. type)

TURBINE-GENERATORS

One 1250 KVA and one 750 KVA 3/60/2300 3600 rpm GE Type ATB condensing 175 lbs. ga. with condensers and all accessories. Three 728 hp Erie City vertical water tube boilers 180 lbs. working pressure available with these turbines—a complete power plant intact.

625 Kva 3/60/2300 3600 rpm GE Type ATB Curtis condensing turbine 125 lbs. ga. with condenser and accessories.

300 KW 3/60/480 3600 rpm Allis-Chalmers with Kerr non-condensing turbine 185 lbs. ga. 15 lbs. back pressure.

STEAM-ENGINE GENERATORS

208 KW 3/60/440 Skinner Unaflow 200 rpm with GE Generator 185 lbs. ga. 15 lbs. back pressure.

75 KW 125 volts D.C. 270 rpm 14 x 12 Harrisburg Foundry Side Crank Engine GE Generator 150 lbs.

50 KW 125 volts D.C. 280 rpm 13 x 11 Harrisburg Foundry Side Crank Engine GE Generator 150 lbs.

25 KW 125 volts D.C. 305 rpm 9 x 9 Harrisburg Foundry Side Crank Engine GE Generator 150 lbs.

MOTOR-GENERATOR SETS ROTARY CONVERTERS

1000 KW 600 v. 900 rpm Westinghouse rotary converter 2300 v. A.C. with switchboard and spare rotor.

750 KW 600 v. 1200 rpm G.E. Type HCB Rotory Converter 2300 v. A.C. with switchboard.

500 KW 600 v. 720 rpm G.E. M-G set direct connected exciter 3/60/2300 Synchronous Motor and control.

750 KW 600 v. 514 rpm G.E. M-G set direct connected exciter 3/60/2300 Synchronous Motor and control.

62½ KW 3/60/2300 Generator with 75 hp 600 v. D.C. Motor 900 rpm Westinghouse.

75 KW 125 v. 1200 rpm M-G set with 100 hp 3/60/2200 Motor.

DIESEL ENGINE-GENERATORS

44 KVA 3/60/440 1200 rpm F-M Generator direct Connected Exciter V-belted to 60 hp Model 42 F-M Engine complete with Air Compressor, tanks, switchboard and voltage regulator.

22.8 KVA 3/60/440 1200 rpm F-M Generator direct connected Exciter direct connected to 30 hp Model 36 F-M Engine, Switchboard and all accessories.

CENTRIFUGAL PUMPS

1000 gpm 231 ft. 1800 rpm Dayton-Dowd with 100 hp 3/60/2200 G.E. Sq. Cage Motor and control.

1000 gpm 35 ft. 1200 rpm 8" Fairbanks-Morse.

500 gpm 125 ft. 1200 rpm 4 x 3 F-M 2-stage.

460 gpm 140 ft. 1800 rpm 3" Fairbanks-Morse.

150 gpm 100 ft. 3600 rpm 2½ x 2½ SHH Allis-Chalmers.

150 gpm 42 ft. 1800 rpm 2½ x 1¾ Dayton-Dowd.

75 gpm 125 ft. 1800 rpm 3 x 2½ Aurora.

MISCELLANEOUS

1600 amp. 15,000 volt 3PST G.E. Type FK-53-B Indoor Oil Circuit Breaker 125/250 v. D.C. Solenoid operated.

Magnetic Brake Type DW Westinghouse 230 v. D.C. 1000 ft. lb. torque.

2—Pipe threading machines—Curtis & Curtis Co. 2" to 8" and 2" to 6".

2—Variable Speed Transmissions—Reeves Size 2—Horizontal open type.

Winch—Clyde Iron Works—Single drum 8" x 12"—14 to 1 reduction.

Air Compressors—Westinghouse Air Brake—Steam driven Size 10½ and 8".

Crane-tilt 3-valve lifting traps 1" and 1¼".

Condenser Tubes—1650 Admiralty Metal 13' x ⅝" O.D. 18 ga.

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500 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

150 KW G.E. SYN. 250 V. 2300/4000 A.C. 900 RPM
150 KW G.E. SYN. 600 V. 2300/4000 A.C. 1200 RPM

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TURBO ALTERNATORS

Complete with Auxiliaries and Control Equipment

1—3650 KVA, 3600 RPM, 2300/3/60, Whse
1—3125 KVA, 3600 RPM, 2300/3/60, Whse

MOTOR GENERATOR SETS

3 phase 60 cycle

1—200 KW, Whse, 900 RPM, 250 V.D.C. to 290 HP 2200 volt Syn. complete with control equipment
1—150 KW Ridgeway, 900 RPM, 250 V.D.C. to 225 HP. 2300/4160 volt Syn. complete with control equipment.
1—65 KW, G.E., 1200 RPM, 125 V.D.C. to 125 HP, 2300 volt Ind. complete with control equipment

SYNCHRONOUS ROTARY CONVERTERS

6 phase 60 cycle

Qu.	KW	Make	Speed	D.C.V.	Trans. V.
1	1500	Whse.	450	250	2300/4160
1	500	Whse.#	1200	250	2300
2	500	GE	1200	600	##
1	500	Whse.	1200	600	##
1	300	Whse.	1200	275	##
2	300	GE	1200	275	##
3	300	Whse.	1200	600	##
3	150	Whse.	1200	275	##

Booster type.
New Transformers, your spec., 5 to 6 months.

Large Size Motors available from stock.

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ALL SIZES VOLTAGE AND CYCLES

3 ph. 60 cy. A.C. Motors
3 ph. 25 cy. Motors
125 Volts D.C. Motors
230 Volts D.C. Motors
550 Volts D.C. Motors

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4—100000# Boilers 275#
1—225000# Boiler 450#
4—1000 H.P. Heine Boilers 225#
2— 825 H.P. B. & W. Sterling Boilers 200#
2— 770 H.P. B. & W. 200# Boilers
4— 600 H.P. B. & W. 200# Boilers
2— 600 H.P. Edge Moor 200# Stokers
4— 500 H.P. Heine 200 lb. Boilers
Smaller Boilers and Fire Tube Boilers also

Several 425# and 550# Turbo-Generators available
20,000 K.W. GE Co. turbo-generators condensers
2—3000 K.W. Turbos @ 350#
1—5000 K.W., G.E. Co., Turbo-Generator Condensing
2—4000 K.W., G.E. Co., Turbo-Generator Condensing
2—2500 K.W., G.E. Co., Turbo-Generator Condensing
2—2000 K.W., G.E. Co., Turbo-Generator Condensing
1—2000 K.W., W. E. & M. Co., Turbo-Generator Con.
2—1000 K.W., G.E. Co., Turbo-Generator Condensing
2— 750 K.W., G.E. Co., Turbo-Generator Condensing
Several 500 KWs. & Smaller Units.

Non Condensing Turbos—300—500—750—and 1000 K. W. & Larger

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OIL COOLED—SINGLE PHASE
60 CYCLE—WITH TAPS

3—2000 KVA GE 13200/26000 to 2300 V.
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2—600 KVA Whse. 3 Ph., 2300 to 440 V.
1—1200 KVA Whse. 3 Ph. 6600Y to 2300 V.
1—15,000 Pitts. 3 Ph., 27680 to 4560 Y V.
4—3333 KVA GE 25 60 cy. 60000/ to 4000/ 6925Y/8000/13850 water and oil cooled
100—50 KVA Whse. 13200/110/220 V.
3—750 KVA GE 13200/2300 V.

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3—883 Kva—2400—240/120
2—400 Kva. Pittsburgh. 25 cy. 1 ph. 6600—440/460
3—150 Kva. Westinghouse. 60 cy. 1 ph. 13200—440
6—75 Kva—2300—230/115
6—50 Kva—2300—230/115

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300 KVA Fairbanks Morse 2400 V.
2—100 KW Chicago Pneu. 250 V. D.C.
250 KW Busch Sulzer 240 V.
250 H.P. Busch Sulzer 257 rpm. Engine.
225 H.P. Buckeye 460 rpm Engine.
192 KW McIntosh Seymour 2300 V.
100 KW Busch Sulzer 2300 V.
2—11,500 & 20,000 Gal. Steel Tanks.
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2—150 HP 150# H.R.T. Boilers
1—168 & 72 KW AC Gens. D/C Engines
1—100 HP Scotch Marine 100 lbs. P.
1—200, 600 & 800 HP Slip Ring Motors
1—125 KW AC Gen. D/C Uniflow Engine
1—200 HP Westge. 440-3-60-900 RPM Motor

H. & P. MACHINERY CO.,
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200, 140, 125, 100 KW AC UNIFLOW SETS
200, 50 KW DC UNIFLOW SETS
Turbo, Water Wheel gen. sets, boilers
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1500 HP Cochrane Lea V open heater
80, 60, 25, 15 HP DC 115V. motors
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All Makes - Capacities - Pressures.
Centrifugal - Rotary - Plunger - Turbine.

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STANDARD EQUIPMENT - UP TO 200 H.P.
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New & Rebuilt Guaranteed Machines.

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ALL TYPES-CAPACITIES 1 to 1000 "CFM"
Electric - Gasoline - Steam Driven.
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Air - Dust - Gases - Steam Vapors.

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Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

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SLIP RING MOTORS

3-PH., 60 Cy.

HP	Volts	Make	Speed
900	2300	G.E.	900
600	2300	G.E.	720
500	2300	G.E.	900
300	440	Al. Chal.	900
250	2300	G.E.	600
250	440/550	G.E.	600
200	2200/440	G.E.	600
150	2200	G.E.	450
150	2200/440	G.E.	600
150	440/220	G.E.	1200
125	440/220	Whse.	1200
125	440/220	G.E.	1200
25	440/220	G.E. (Hoist)	900
100	440/220	G.E. MTC	900
100	440/220	Whse.	1200
100	440/220	G.E.	1200
80	440/220	G.E. (MTC)	900
75	2200	Al. Chal. (new)	900
75	440/220	G.E. (MTC)	600
75	2200/440	G.E.	1200
50	2200/440	G.E.	600
75	550	G.E.	900
40	2200	Whse.	900

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1—3000 ampere, type FK 25, General Electric, 3 pst, 600 volt.

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3-PH., 60 Cy.

500	2200	Al. Ch.		450
300	440/220	G.E.	ATI	600
300	4150/2300	Cr Wh.	SYN	900
300	2200	Whse.	G	720
300	440/220	Al. Ch.		600
250	4000/2300	G.E.	TS	1200
240	2200	G.E.	ATI	600
200	4150/2300	Whse.	G	1800
200	2200	G.E.	ATI	514
150	4150/2300	Whse.	G	1800
110	440/220	G.E.	TS	1800
100	440/220 25 cy.	G.E.	TS	375

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2— 100 kva., G.E., type H 2400-240-480.
3— 100 kva., G.E., type H-KDD, 6900/11950Y-230/

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HP	Volts	Make	Type	Speed
500	440/220	G	IK	1200
500	440/220	G.E.	IK	900
400	2200/440	Whse.	CS	720
400	2200/440	G.E.		600
400	550	G.E.	IK	720
350	440	G.E.	IK	900
200	440/220	Whse.		1200
200	2200	G.E.		1800
200	440/220	Wagner	RP	1800
200	2200/550	Al. Ch.	AR	900
150	2200/550	Al. Ch.	AR	1800
150(3)	440/220	G.E.	KT	1200
125	2200	G.E.	KT	600
100	440	G.E.	IK	450
100	2200	G.E.	KT	1800
100	440	Whse.	CS	1200
74	2200	G.E.	KT	900
50	2200	Al. Ch.		720

MOTOR GENERATOR SETS

1—100 kw, 250 v., 900 rpm, Whse., conn. to 150 hp, 2300 v., 60 cy., sq. cage motor
1—60 kw, 250 v., 1200 rpm, G. E., conn. to 90 hp, 440/200 v., 60 cy., syn. motor
1—60 kw, 125 v., 1200 rpm, Whse., conn. to 75 hp, 440/220 v., 60 cy., syn. motor.
1—35 kW, 125 V., 1800 RPM., G.E., conn to 50 HP., 440/220 V., 60 cy., squirrel cage

A.C. GENERATORS

1—300 kva, 600 rpm, 440/220 v., G. E.
1—225 kva, 600 rpm, 440/220 v., G. E.
1—190 kva, 514 rpm, 2200/440 v., G. E.
1—150 kva, 900 rpm, 440/220 v., G. E.
1— 98 kva, 1800 rpm, 440/220 v., G. E.
1— 38 kva, 360 rpm, 480/240 V. G.E.

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937 KVA GE 2300 v. Cond.
750 KVA GE 2300 v. Cond.
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1—27"x36" Skinner Uniflow, direct connected to 562 KVA AC Generator, complete.

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Manning, Maxwell, & Moore 47'4" Span
Shaw 35' Span
Champion 37'6" Span
American 70' Span
American 47'4" Span
6-Ton
P&H 77' Span
American 77' Span
7½-Ton
Shepard 36' Span
10-Ton
Shaw 68' Span
Shaw 73' Span
P&H 30' Span
P&H 87'6" Span
P&H 80' Span
Northern 71'10½" Span
Northern 60' Span
Morgan 55'6" Span
Morgan 39'5" Span
Morgan 52'3" Span
Milwaukee 66'9" Span
McGill 85' Span
Lane 50' Span
Enco 75' Span
Dominion 35' Span
Cleveland 38'½" Span
Cleveland 50' Span
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Alliance 58'9" Span
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Northern 60' Span
Morgan 60' Span
Cleveland 65' Span
25-Ton
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Tyssman 60' Span
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Morgan 52'3" Span
Cleveland 106'Span
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Whiting 80' Span
P&H 80' Span
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Morgan 30' Span
Case 41' Span
35-Ton
Bedford 50' Span
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Shaw 95' Span
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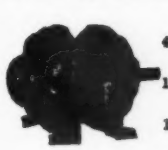

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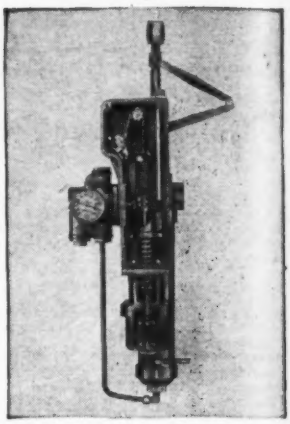

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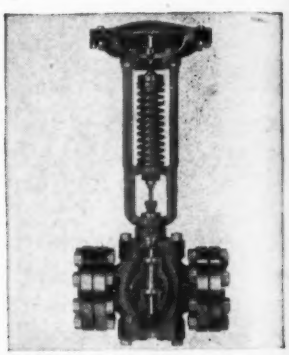

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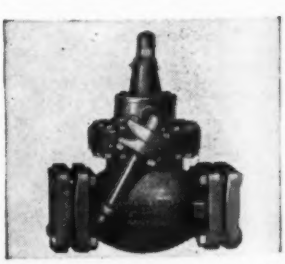

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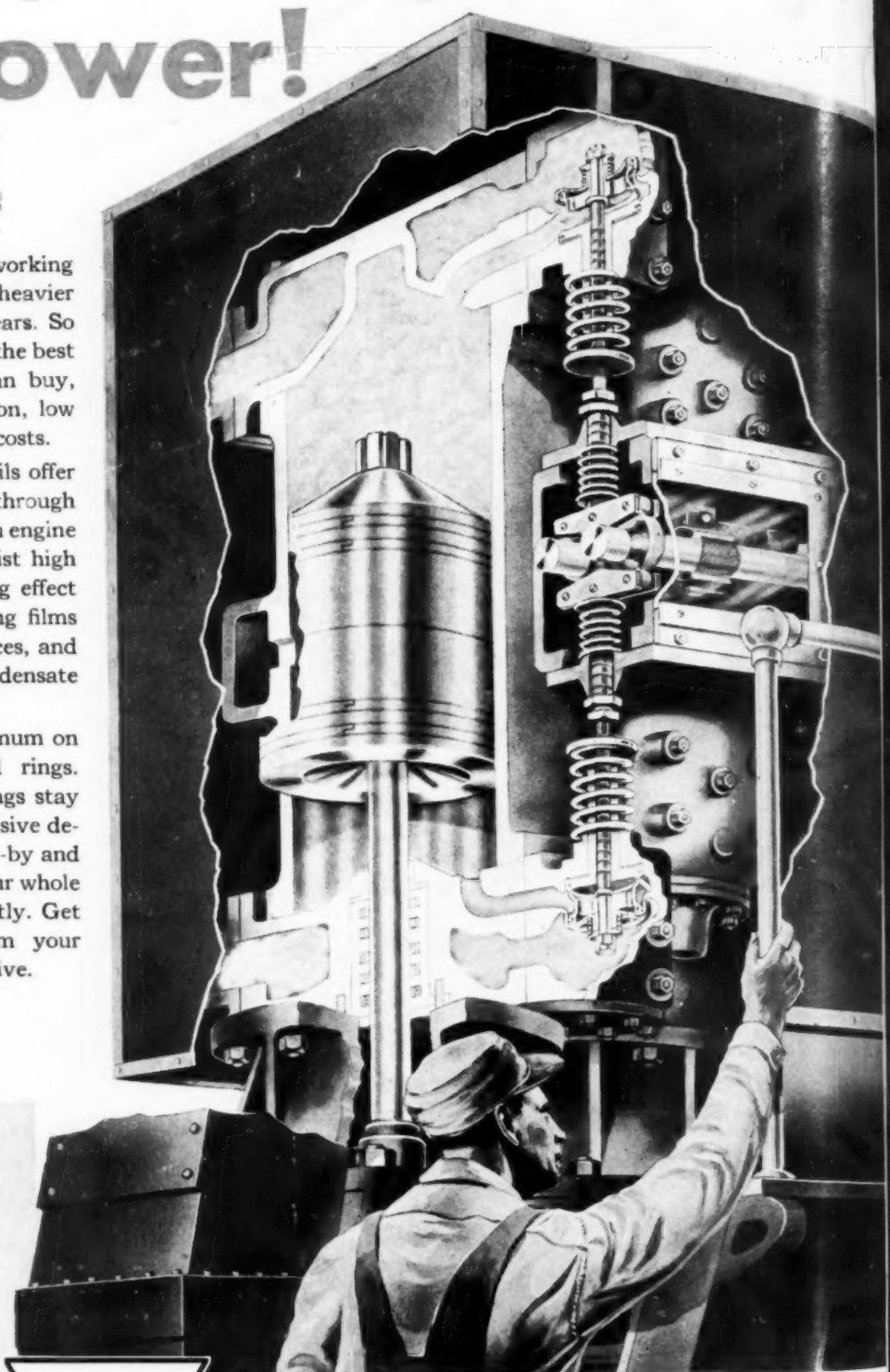

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